UNIVERSITY OF NATAL

PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1955–1956

(NINTH YEAR)

OCTOBER, 1956

COMMONWEALTH MYCOLOGICAL INSTITUTE
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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3) :

S. Clegg, Esq. (*Chairman*).

Major C. J. J. Crowe.

R. B. Fyfe, Esq.

Appointed by the University of Natal (2) :

Professor A. J. W. Bayer, D.Sc. (*Vice-Chairman*).

Principal E. G. Malherbe, M.A., Ph.D., LL.D.

Alternate: Professor A. R. Saunders, D.Sc.Agric.

Appointed by the Union Government Department of Forestry (1) :

C. E. Lack, Esq., B.Sc.

The Director :

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary :

P. G. Leeb-du-Toit, Esq., B.Com. (Registrar, University of Natal).

STAFF

(SEPTEMBER, 1956)

DIRECTOR :

H. Shaw, M.Sc.Tech., Ph.D.(Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A.(Oxon.), B.Sc.(South Africa).
K. Roberts, B.Sc.(Wales).

Technical Assistants:

M. J. Lourens.
T. B. Oatley. (*Resigned April*, 1956).
A. M. MacKenzie. (*Appointed January*, 1956).
J. H. Scheltema. (*Appointed July*, 1956).

Genetics and Plant Breeding:

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc.(Natal).

Technical Assistant:

B. L. Arbuthnot.

Chemistry:

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, B.Sc.Hons.(Natal).

Technical Assistant:

R. A. Jones.

Entomology:

L. L. J. Ossowski, M.F., For.Ing., D.Sc.(Poznan).
C. N. Smithers, M.Sc.(Rhodes), F.R.E.S. (*Resigned December*, 1955).

Technical Assistants:

G. B. Wortmann.
R. R. Hawkins. (*Appointed January*, 1956).

Administration:

Miss E. K. Smith.

Non-European:

Six.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

Two events, not without some relation to each other, have marked out the past year as a landmark in the Institute's short history. On the one hand, the first crop has been reaped from trees established since the inauguration of the Institute. It is true that only a few plots of seven-year old trees, comprising the shortest rotation in a large thinning experiment, were involved, but the crop was significant as being the forerunner of a continuous and increasing flow of experimental material. This prospect, added to the work already on hand, has led to the other notable event of the year, the first substantial addition to the Institute building since its erection. As described in the Report, this became necessary to enable the Chemistry Section to handle efficiently the large number of bark samples coming in for analysis. The opportunity has been taken also to effect a much-needed renovation and re-decoration of the exterior of the building.

The year was further notable for a policy decision of the highest importance, namely to embark on a series of field experiments directly controlled by Institute staff in the wattle areas of the Eastern Transvaal and Northern Natal. Unfortunately, however, it has so far not been possible to implement this decision because no suitable officer to undertake the work has been found.

It will be evident that the Review of Work in Progress presents only a single year's advance in what are, for the most part, long-term investigations. It is assumed that the reader is familiar with, or has available for reference, earlier accounts of the work and that, in consequence, annual repetition of details of layout and procedure is unnecessary.

The extreme difficulty of recruiting staff is proving a severe handicap to the work of the Institute; the research staff is actually fewer in number at present than it has been at any time since 1953, and several projects are held up in consequence. Inevitably, this is also having an adverse effect on the output of publications, but nevertheless, one paper in an outside journal was published during the year and three others are at present in the Press. These papers are referred to in the Report.

H. SHAW, *Director.*

October, 1956.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Building.

The optimistic view expressed a year ago that all the troubles of unsatisfactory approach roads had come to an end proved to be somewhat premature. The first stage of the road work had been carried out, but it was well on in the current year before it was completed, and there were some rather unhappy periods in between. Now, however, an all-weather entrance from Carbis Road is an accomplished fact, and no visitor need look with apprehension upon a visit to the Institute, even in the wettest season.

Major works have been carried out on the building itself. To meet the urgent need of the Chemistry Section for increased accommodation for the drying of bark and its preparation for analysis, the upper floor has been completed by building out over the portion of single-story flat roof at the back of the Institute. The resulting four additional rooms have provided for the desired expansion and have also made possible a rationalization of the whole process of handling the large volume of incoming bark samples. This extension has solved incidentally the rapidly-developing problem of an unsatisfactory section of roof.

At the same time, sundry repairs, renovations, and alterations that had become necessary were carried out and the whole of the exterior was re-decorated in a colour scheme rather easier on the eye than the original glaring white.

The completion of these operations will make it possible to go ahead with the layout of the immediate surroundings of the building; the final development of the site as a whole, however, is not yet in view.

Field Experiment Station.

The road system of nearly 20 miles, serving all existing plantations, has now been completed and only a few miles of light work in anticipation of future development remain to be done. All this has been accomplished using only the normal farm equipment and labour force.

About 38 acres have been re-established under experiments and 5 acres of new land added to the genetics experiments. The total area of experimental plantations on the farm is now very close on 250 acres. Bagworm is present throughout the farm, but no commercial spraying was carried out in 1955. A small area was, however, sprayed experimentally. An attack of frog-hopper was controlled without much difficulty.

With a return to a normal quota of felling, the farm has again shown a working profit following the loss last year due to the small acreage stripped.

ADMINISTRATION AND FINANCE

There were no changes during the year in the composition of the Committee of Control, but because of business visits overseas, the Chairman, Mr. S. Clegg, was able to attend only one meeting. In his absence, Professor A. J. W. Bayer officiated as Acting-Chairman. Three ordinary meetings and one special meeting were held. Dr. A. R. Saunders was nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

Discussions, initiated by the Wattle Growers' Union, have taken place with a view to securing an increase in the Government Grant to the Institute. A deputation interviewed government officers in Pretoria in March and was well received, but so far there has been no further development.

Expenditure and Income.

During the year, there has been considerable extraordinary expenditure as described under "Buildings and Plantations". The cost of the additions to the Institute building amounted to approximately £2,500, while some £860 was spent on repairs, alterations, and re-decoration. Although only £200 of this amount was provided on the estimates for 1955-56, the total estimate of £25,000 for the year was exceeded by less than £400. This was possible because of the vacant posts provided for but not filled, and by substantial savings both on equipment and on consumable stores. A further heavy item of expenditure was the replacement of the Dodge panel van by a Willys station wagon at a net cost of £1,050. Total expenditure for the year was, as anticipated, about £4,000 more than in the previous year.

Fees received during the year for analytical services amounted to £203 14s. 0d., an appreciable increase over the previous year due to the larger number of Bark Inspector's samples examined. The net excess of expenditure over the estimate was thus reduced to £165.

The summarized statement of Expenditure and Income for the period 1st September, 1955, to 31st August, 1956, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1955, to 31st August, 1956

Expenditure	£	s.	d.
Research and Administrative Staff Salaries, etc.	17,517	19	9
Travelling and Subsistence	921	4	8
Laboratory and Office Equipment and Maintenance	1,238	2	1
Station Wagon (less trade-in)	1,050	0	0
Library	281	5	9
Printing and Stationery..	225	2	11
General Administration ..	788	19	8
Building Maintenance ..	859	19	9
Building Additions	2,486	9	0
	£25,369	3	7

Income	£	s.	d.
S.A.W.G.U. Grant ..	20,165	9	7
Department of Forestry Grant	5,000	0	0
Analytical Services ..	203	14	0
	£25,369	3	7

STAFF

Mr. C. N. Smithers resigned his appointment as Assistant Entomologist in the Institute in December, 1955, and thus far has not been replaced. This has greatly hampered the work of the Entomology Section, and certain lines of work have been discontinued pending the appointment of a successor.

During the year, following recommendations from the Committee of Control, authority has been received to establish two new posts, namely a Statistician to deal with the special problems of planning and analysis arising in the Institute's experimental work and an Assistant Silviculturist to supervise a programme of field experiments in the northern wattle districts. These three posts, together with the long-vacant post of Plant Physiologist, were twice advertised widely in the Union and overseas without a single appointment resulting. This difficulty in recruiting suitable research staff is seriously interfering with the normal, and in some cases urgently needed, development of the research programme and is placing an undue burden upon present members of staff.

Two of the junior staff of the Silviculture Section, Messrs. I. J. Meiklejohn and T. B. Oatley, resigned in September and April respectively and were replaced by Messrs. A. M. MacKenzie, in January, and J. H. Scheltema, in July. In January also, Mr. R. R. Hawkins joined the Entomology Section as an additional assistant. All three were appointed in the first instance as Junior Technical Assistants.

Mrs. P. M. Allison was employed in a temporary capacity from late November to the end of 1955 during Miss Smith's absence on sick leave.

Although the Wattle Research Institute Scholarship was increased in value and the conditions of tenure made more attractive, no application was received.

Mr. G. Smit, a Forestry Graduate of Wageningen University who is reading for an M.Sc. degree in Forestry at Stellenbosch University, spent the first half of August at the Institute studying experimental and statistical methods as applied to research on wattle. For most of this period, he worked with the Silviculture Section. Several Natal University students were employed during vacations as temporary assistants in the Entomology Section and two pre-University students were voluntary workers in the Silviculture Section for several weeks.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

There was a further decrease in the number of advisory letters written (242), due in the main to a reduction in the number of purely routine enquiries received. The geographical distribution was again wide, enquiries coming from fifteen countries including, for the first time, China, Madagascar, The Netherlands, Russia, and Switzerland. The preponderance of letters relating to insects and pest control (117) continued, with silviculture (50) an easy second as usual. Other notable topics were the composition and properties of bark and extract, and the economics and general prospects of the industry. Many other enquiries were answered by telephone and in the course of growers' visits to the Institute.

The 44 advisory visits to growers' plantations by the Silviculturist covered the whole of the recognized wattle-growing areas except Zululand, while the Entomologist's 95 visits were mainly in the Natal Midlands, but included Vryheid, Paddock, and Pondoland also. The whole staff of the Entomology Section spent a large proportion of its time in growers' plantations during the 1955 aerial spraying operations against bagworm and in preparation for the 1956 campaign. At present, this Section is carrying full responsibility for the technical direction of the bagworm survey and consequent control measures. This supervision of the commercial spraying programme reacts very seriously upon the research activities of the Section and, particularly in view of the reduced staff, cannot be continued at the present level without prejudice to other work.

At about 80, the total number of visitors to the Institute was less than in the previous year, due to the absence of any large party this year. The number of separate individuals and small groups was little different. Among the visitors were Professor C. L. Wicht, of the Institute of Forestry and Wood Technology, Stellenbosch University, and Mrs. Wicht, Mr. George Ordish, Agricultural Economist to Messrs. Plant Protection Limited, Dr. E. B. Worthington, formerly Scientific Secretary of the East African High Commission, and Mrs. Worthington, Dr. A. H. Lewis, Director of Imperial Chemical Industries Limited Jealott's Hill Research Station, Dr. J. B. van Zyl, now C.S.I.R. Liaison Officer on the continent of Europe, and Mr. P. H. Nye, of the Department of Agriculture, University College of the Gold Coast. Other visitors came from England, France, Madagascar, The Netherlands, Northern and Southern Rhodesia, Scotland, and Swaziland.

For the first time since its inception, the Farmers' Field Day at Bloemendal was seriously affected by the weather. Two sections were again arranged, for the 22nd and 23rd March, but following several days of almost incessant rain, it was doubtful to within an hour or two of the time arranged whether it would be possible to proceed. In the event, there was no interruption, but conditions were very bad and in the circumstances, it was most gratifying that at least 100 visitors attended. Those who did showed great interest in the talks and demonstrations and were unanimous in their expressions of satisfaction. In addition to casual visitors, several other parties including growers, Extension Officers, and a group of agriculture students were conducted around the farm.

The Institute has again advised a number of public authorities, among them being the Union Government Departments of External Affairs and of Forestry, the Natal Provincial Roads Department, Natal Local Health Commission, the Colonial Development Corporation in London, in Swaziland, and in Tanganyika, the Colonial Pesticides Research Committee in London, the Interafrican Bureau of Soils, the Food and Agriculture Organization of the United Nations, and the Government Departments of Forestry in Ceylon and Argentina. Many of these enquiries called for statistical and economic information about the wattle industry, while others referred to technical problems of production and utilization.

Two commercial organizations were advised, and material supplied, in connection with the production of educational strip films. One film, in preparation in England, is

concerned with the wattle industry while the other, being made in South Africa, deals with Pietermaritzburg and district. A more ambitious project in which the Institute's help has been sought is the production by the State Film Services of a two-reel educational film on the wattle industry for the Union Department of Education. Through the Provincial Department of Education, the Institute was invited to advise on the planning and production of this film, and members of the staff have already assisted in preparing the scenario and in selecting suitable locations.

There has been a marked increase in the number of check samples of wattle bark analysed for the Government Bark Inspector and these, while in the main confirming the official grading, have revealed some discrepancies in barks from unusual sources. Other samples of bark, extract, and spent bark have been analysed at the request of manufacturers, in several cases for the certification of export parcels.

The Entomology Section conducted on behalf of the Wattle Growers' Union all the technical aspects of the annual bagworm survey, from preparing the forms to analysing the results. The Section later checked and co-ordinated all the applications for spraying in the 1956 season.

From time to time, the Institute has experienced a need for information about the location and scale of wattle production outside Africa, and enquiries received have revealed interest in this in other quarters. Consequently, an attempt has been made to fill the gap by consulting responsible authorities in producing countries, and figures are now available for all but two minor centres. Incidentally, the inadequacy of F.A.O. published figures has been revealed and pointed out.

Members of the Institute staff have prepared several papers of a general survey or advisory nature, apart from normal research publications. The Director wrote the section on the Wattle Industry in Natal for the forthcoming Oxford University Press publication on Agriculture in the Natal Regional Survey series. The article by the Director entitled "The Contribution of the South African Wattle Growers' Union to Research on Wattle" appeared in October in the Leather Industries Research Institute's new publication "Wattle Tannin and Mimosa Extract" and is reprinted on page 26 of this Report. Dr. Ossowski wrote the special booklet for growers "A Guide to the Assessment of Wattle Bagworm Infestations" which was published, with illustrations in colour, by the S.A. Wattle Growers' Union.

The Institute planned and built up the Wattle Industry Exhibit at the Royal Agricultural Society's 1956 Show in Pietermaritzburg. This exhibit emphasized the need for producing high quality bark and particularly stressed the part played by protection against pests, diseases, and fire. Protection of the soil was demonstrated by means of a working model illustrating the ravages of excessive run-off and consequent erosion. The exhibit was awarded the equivalent of a Gold Medal.

Committees, etc.

The Director paid his usual visit to the Leather Industries Research Institute for the Annual Meeting of the Research Advisory Council held in Grahamstown on the 21st June, 1956. The Wattle Technical Committee met on the previous day.

The Director attended all the meetings of the General Committee of the Wattle Growers' Union and was a member of the preparatory committee and of the deputation which interviewed government officers to discuss the possibility of an increased Government Grant in support of the Wattle Research Institute. He served also on the Union's Mechanization Committee and, with Mr. Sherry, on the Field Experiment Station Committee and the Royal Show Exhibit Committee; along with Dr. Ossowski, he served on the Union's Pest Control Committee. The Director assumed office in September as Chairman of the Steering Committee for the Wattle Timber Research Fellowship at the National Chemical Research Laboratory, and in this capacity, has discussed with officers of the C.S.I.R. matters pertaining to the appointment of a Fellow.

At the request of the Wattle Growers' Union, the Institute assembled and analysed copies of the laws and regulations relating to fire protection in Australia, New Zealand, Canada, the non-self-governing Commonwealth, and the United States. This information was then placed at the disposal of the Union's Fire Laws Sub-committee on which Mr. Sherry played a leading part. In this connection, Mr. Sherry has taken part in discussions with officers of the Department of Forestry and of the Division of Soil Conservation both locally and in Pretoria, with several Soil Conservation District Committees, and with the Natal Midlands Fire Protection Association. He was also responsible for the technical drafting of proposed legislation on this subject.

The Inter-Departmental Committee studying the problem of encroachment of wattle on Native Reserves, on which Mr. Sherry served, completed its work and reported to the Minister of Native Affairs. Mr. Sherry continued to serve on the Committee of the Botanic Society of Natal.

Conferences, Lectures, Meetings, etc.

Mr. Sherry has addressed District Committees at Kranskop and Greytown on fire control regulations, while Dr. Ossowski spoke to local groups of farmers at Dalton and New Hanover on the organization of aerial spraying against bagworm.

Dr. Martin and Mr. Sherry jointly gave a talk on Soil, Plant Foods, and Silviculture in Relation to the Wattle Industry to a conference of Natal School Science Teachers in Pietermaritzburg.

LIBRARY

Only 11 books were added to the Library during the year, bringing the total to 257, but there was a record influx of bulletins, reprints, etc., the 260 received making a total of 1,938. There are now 280 bound volumes of periodicals in the Library. During the year, one new periodical and three new annual reports have been added to the collection.

The Institute gratefully acknowledges gifts of "The Forestal Story" from the Forestal Land, Timber and Railways Co., Ltd., and "Wattle Tannin and Mimosa Extract" from the Leather Industries Research Institute.

ACKNOWLEDGMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned for assistance rendered during 1955-56.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To Dr. K. Schedl in Austria for the identification of beetles damaging pine timber.

To Dr. W. J. Hall, Director of the Commonwealth Institute of Entomology, for invaluable advice and assistance in connection with the preparation of coloured plates for the booklet on wattle bagworm infestations.

To Professor A. A. Rayner, of the Faculty of Agriculture in the University of Natal, for advice on statistical problems.

To the Comec Mimosa Extract Co., Ltd. and The Natal Tanning Extract Co., Ltd. for facilities for dealing with the chipped bark in the sampling experiments.

To all those growers who have placed portions of their plantations at the disposal of the Institute for experiments, and to those who have reported the incidence of wattle pests and sent material for the Institute's insect collection.

To the management and research officers of The Natal Tanning Extract Co., Ltd., for copies of internal reports on matters of interest to the Institute.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

The three experiments S.1, S.3, and S.5, were designed to determine, for different site qualities, the optimum final density in relation to length of rotation.

(*a*) The first portion of experiment No. S.1 at Broadmoor (Wartburg district) was harvested in March, 1956, at seven years of age. At the same time, the remaining portions of this experiment, which are due to be harvested at nine, eleven, and thirteen years of age respectively, were re-measured.

Analysis of these measurements showed that plots at densities of 500 and more trees per acre were significantly suppressed (P=0·05) in relation to plots at densities of 350 or fewer trees per acre.

Results obtained from the harvested plots were as follows:

Number of trees per acre at harvesting	Mean d.b.h. inches	Mean percentage tannin content (moisture-free basis)	Mean green bark yield (long tons per acre)	Mean tannin yield (long tons per acre)
1,000	3·67	33·37	7·89	1·30
900	4·13	34·30	9·84	1·66
800	4·13	35·07	8·07	1·39
750	4·17	36·03	8·43	1·52
700	4·70	36·97	9·40	1·71
650	4·63	36·27	8·46	1·50
600	4·80	35·97	8·51	1·49
550	4·70	35·83	8·24	1·44
500	4·90	36·43	7·72	1·39

	D.b.h.	*Tannin content*	*Bark yield*	*Tannin yield*
Standard error	0·15	0·53	0·64	0·12
Significant difference (P=0·05)	0·44	1·59	1·92	0·36
Significant difference (P=0·01)	0·61	2·19	2·64	0·49

Breast height diameters showed that plots at densities of 750 and more trees per acre were significantly suppressed in relation to plots standing at 700 or fewer per acre. Differences in mean diameter between plots in the 700 to 500 range, however, were not significant. It may be assumed, therefore, that the maximum density permissible on this site for a seven-year rotation is 700 trees per acre.

The percentage tannin content of the bark increased with decreasing density from 1,000 to 750 trees per acre and thereafter remained approximately constant over densities from 750 to 500.

Apart from one anomalous result, the bark yield increased gradually with decrease in density from 1,000 to 700 per acre and decreased again with continued decrease in density from 700 to 500. Similarly, the computed yield of tannin per acre showed an increase with decreasing density to a maximum at 700 trees per acre, with a corresponding fall thereafter as density decreased to 500 per acre. The high mean yield shown by plots at a density of 900 trees per acre was mainly due to an exceptionally high bark yield from one plot, apparently the result of favourable site conditions rather than of treatment.

Although any one density was not significantly superior to all others in this trial, there is some evidence that the optimum density for a site of this quality over a rotation of seven years lies around 700 trees per acre. The analytical results, however, show that the adoption of so short a rotation has produced bark well below the desirable minimum standard of quality.

(*b*) Experiment No. S.3 at Bloemendal (Pietermaritzburg district) was measured in June, 1956. At five and a half years of age, plots at densities of 500 and more trees per acre in two sections of this experiment were significantly suppressed ($P = 0{\cdot}05$) in relation to plots at densities of 400 or fewer per acre. In the third section, however, only plots at 550 and more trees per acre were significantly suppressed ($P = 0{\cdot}05$) in relation to plots at 400 and fewer trees per acre, as was the case at four years of age.

(*c*) Experiment No. S.5 on the Clan Syndicate Estate (Albert Falls district) was re-measured in August, 1956. At four years of age, plots at densities of 650 and more trees per acre were significantly suppressed ($P = 0{\cdot}05$) in relation to plots at densities of 500 and fewer.

(*d*) Experiment No. S.28 was laid down at Bloemendal in February, 1955, to compare the effect on growth of the following treatments:

A. Trees in six foot rows, thinned selectively for vigour.

B. Trees not in rows, thinned selectively for vigour.

C. Trees in six-foot rows, thinned by removal of every other tree in the row at each operation.

D. Trees in six-foot rows, thinned selectively to remove all trees showing symptoms of gummosis.

At each operation, all plots were thinned to the same number of trees. The mean seedling heights in feet at eleven months were as follows:

Thinning method	Mean height
A. Selection in rows for vigour	8·27
B. Selection without rows for vigour	9·13
C. Removal of alternate trees in rows	6·78
D. Selection in rows for removal of diseased trees	6·66

Standard error	0·43
Significant difference ($P=0{\cdot}05$)	1·39
Significant difference ($P=0{\cdot}01$)	1·99

There were no significant differences in mean height between the two sets of plots thinned selectively for vigour, but both were significantly better than plots thinned by the removal of alternate trees and those in which all trees with gummosis were removed.

It would appear, therefore, that little is to be gained by dispensing with rows when establishing wattle plantations, since selection is not materially improved thereby, and both thinning by count and tasking of labour are made more difficult. It is not possible at this stage of the experiment to say whether the removal of all trees showing early symptoms of gummosis is a desirable practice or not. Such trees are often dominants and their removal will tend to reduce the mean height of the stand, whereas, if left, many of them may recover and produce satisfactory bark. On the other hand, some will ultimately become infected by the spores of wood-rotting fungi and may die or at least prove difficult to strip, and this may result in a greater reduction in yield than that caused by the removal of some diseased dominants in the early stages. It is hoped that further information will be obtained on this point when this experiment is harvested.

2. Thinning and Weeding in Relation to Disease Incidence.

Experiment No. S.2 at the Umvoti Wattle Company Estate (Kranskop district) was thinned in May, 1956, at six and a half years of age with the object of removing trees which were seriously suppressed or diseased and which would probably not strip at rotation age. Such an improvement thinning in a normal stand at this age may be expected to remove about 50 trees per acre, but the incidence of disease was so high in this experiment that it was found necessary to thin the plots from 500 to 400 trees per acre in order to remove all the dead trees from the most severely affected plots. The mean yield of bark from this thinning was 0·57 tons per acre, but differences in bark yield between plots were considerable and followed no regular pattern which could be associated with treatment. They were apparently due in the main to variations in the amount of bark which could be stripped from diseased trees according to the stage of development of the disease condition.

3. Effect of Different Methods of Soil Preparation upon Growth.

Experiment No. S.27 was laid down at Bloemendal in November, 1954, to compare the growth of wattle on virgin grassland prepared for planting in the following ways:

A. Land ploughed in autumn and again in the following spring prior to planting the crop.

B. Land ploughed in autumn only.

C. Land strip-ploughed in spring just prior to planting. Ploughed strips were three feet wide alternating with strips of undisturbed grass of the same width.

D. Land strip-hoed in spring just prior to planting. Grass was hoed from strips three feet wide alternating with unhoed strips of the same width.

In all four treatments, the trees were established by sowing in furrows prepared at six-foot intervals on the contour, superphosphate fertilizer being applied some two inches under the seed at a rate of 200 pounds per acre.

Each plot was split into two sub-plots, one of which was clean-hoed when the seedlings were about two feet high, the other being left untouched. The mean seedling heights at fifteen months of age were as follows:

Soil preparation	Height in feet		
	Hoed	Not hoed	Mean
A. Ploughed autumn and spring	5·39	4·29	4·84
B. Ploughed autumn only ..	5·79	4·34	5·07
C. Strip-ploughed spring ..	5·47	3·24	4·36
D. Strip-hoed spring	4·44	2·73	3·59
Mean	5·27	3·65	—

	Soil preparation	*Hoeing*	*Interaction*
Standard error	0·23	0·14	0·28
Significant difference (P=0·05)	0·72	0·43	0·85
Significant difference (P=0·01)	1·04	0·60	1·19

Owing to the rough nature of the ground and the lightness of the tractor employed, the soil was not well broken up in the two complete ploughing treatments. The differences in height growth between trees in completely ploughed and strip-ploughed plots were, therefore, not so marked as might otherwise have been the case and were not significant. Height growth in strip-hoed plots was, however, significantly poorer (P=0·05) than in any of the ploughed treatments.

The height growth in plots in which grass growth between the tree rows was removed by hoeing was significantly greater (P=0·01) than in those which were not hoed. Within

soil preparation treatments, the differences between hoed and unhoed plots were also highly significant, but were smaller in treatments involving complete soil preparation than in those in which preparation was carried out stripwise, and smallest of all in plots which were ploughed twice. This suggests that the reduction in root competition due to the removal of weeds may not be the only factor responsible for enhanced growth after hoeing, but that improved tilth also plays a part.

(b) GENETICS AND PLANT BREEDING

1. General.

Over the past few years, a considerable amount of basic material has been built up in the several lines of breeding being followed in wattle. In all, some 45 acres of land at Bloemendal are now being used for genetics and breeding. It is inevitable, with the slow growth of wattle, that a stage should be reached when there must be some delay before trees flower and the next steps in the breeding programme can be taken. This applies more particularly to work on interspecific hybrids, inbred lines, and tetraploids. All these lines are being continued and new material added, but at this interim stage, there is little to report. Study of the material has, however, given some information which is discussed under the appropriate headings.

The selection of trees within black wattle (*Acacia mollissima*), with the testing of their genetic potential by means of progeny trials, promises to be one of the most rewarding lines of work and has been receiving more and more attention. Practically every character studied, whether in relation to vigour, form, or disease resistance, has shown significant differences between the progenies from individual trees, indicating the genetic variability of the parents for these characters. Possibly one of the most important findings is the strong evidence of resistance to gummosis and black butt carried by certain of the selected trees. The work has now progressed to the stage where a number of trees have been located which, as judged by progeny tests, are considerably better than average in this respect, and cuttings have been struck with a view to bringing these trees together to inter-pollinate.

Unfortunately, no satisfactory method of sampling and assessing the tannin content of living trees has yet been found. Although pellets of bark taken from the trees give some indication of the relative tannin content, the results are unreliable and for the present, selection must be based on bark thickness and tree diameter, characters which are usually correlated with tannin content.

2. Interspecific Hybrids.

(*a*) *Green and black wattle hybrids.* During the year, the analysis of leaf characters in F_2 families and back-crosses to the green and black parents was continued. Four of the characters which were considered to show best the differences in leaf form between the species were chosen for detailed analysis. These characters were the number of pairs of pinnae, pinnule number, pinnule length, and space between the pinnules. As mentioned in last year's Report, pairs of characters showed for the most part some correlation both in the F_2 and back-crossed families. There were, however, some abrupt and significant changes in correlation value between F_2 families derived from sister F_1 trees. For example, three F_2 families gave significant correlations of $r = +0{\cdot}543$ (d.f. 59), $r = +0{\cdot}624$ (d.f. 98), and $r = +0{\cdot}666$ (d.f. 39) for pinnule number and pairs of pinnae, while a fourth family had a correlation coefficient of $+0{\cdot}051$ (d.f. 37) for the same pair of characters. The difference between this last correlation coefficient and the other three is highly significant. Similarly, the characters pinnule spacing and pinnule length showed significant correlations in the F_2 families, but the difference in values of r between families was also significant. Correlation between parental characters in the progeny of interspecific hybrids may be due to a number of causes, but it would seem likely that in the present instance, a change in the linkage relations of the characters accounts for the changes in values.

Leaf form in back-crosses to green and to black wattle approached very closely to the respective parental types. Indeed, in one back-crossed family, the number of pairs of pinnae exceeded not only that of the recurrent black wattle parent, but also the highest number so far recorded in this species.

Scoring for date of flowering and time taken to ripen seed was continued at monthly intervals until the middle of December, when a severe attack of bagworm partially defoliated the trees and destroyed flower buds and young pods, rendering further recording impossible.

(*b*) *Black wattle* × Acacia baileyana. *A. baileyana* appears to be very resistant to damage by frost or cold winds and is, therefore, a possible source of cold tolerance. It is a very glaucous species having strikingly grey-green leaves, and there is a suggestion that the glaucous character may be concerned with cold resistance. F_1 hybrids planted at Bloemendal in 1952 flowered for the first time during the season. Pods failed to set under bags, possibly due to damp weather conditions, but the hybrid trees set a considerable amount of seed from an earlier out-of-season flowering. Because of the date of this flowering, it was concluded that the seed set must have been due to self-pollination. A family grown from this seed showed a range of chlorotic types in the seedling stage very similar to that occurring in green and black wattle hybrids (Annual Report, 1952-53).

The leaf characters in the F_1 hybrids were approximately intermediate between the parents, while the presumed F_2 showed a wide range of recombination. The F_1 hybrids had only a slight trace of glaucousness while in the F_2, although the character was more pronounced in some trees, the full expression was not recovered. It was noticeable that the F_2 trees which showed the highest degree of glaucousness were closest to *A. baileyana* in leaf form and plant habit.

3. Progeny Testing of Selected Trees.

The limitation imposed upon the screening of a large number of parent trees by the low stocking per acre at which wattle is grown emphasizes the need to secure the highest possible percentage stand. Only in this way can plot size be kept to the minimum and the number of families compared increased without serious loss of accuracy or prohibitive increase in the area of land used. A considerable amount of attention has, therefore, been paid not only to plot size and layout, but also to field methods designed to obviate the heavy losses previously experienced.

In the main, these have been caused by the blowing over of young trees, attacks by cutworms immediately after planting, and damage by hares when the trees were about one foot high; very few seedlings died because of climatic factors.

The blowing over of trees, usually when they were six months to one year old, was caused by the spiralling of the tap-root round the inside of the pot when ordinary earthenware pots were used to raise the seedlings. On transplanting, the curled tap-root thickened, giving a "spiral-spring" effect which gave the young tree insecure anchorage or even pushed it out of the ground. The use of paper pots having no bottom prevented the spiralling of the tap-root and losses from blowing over have now been reduced to negligible proportions. The fact that the seedlings are not removed from the pot for transplanting has greatly simplified handling and reduced errors when transferring to the field.

While the use of paper pots solved one problem, it caused another. When earthenware pots were used, an extensive root system developed inside the pot and seedlings could be grown to a height of six to eight inches before transplanting, at which stage they were too large to be damaged by cutworms. When, however, paper pots without bottoms are used, the roots grow straight through and have to be cut back periodically. Because of the small root system which develops inside the pot, the seedlings will not grow to more than about $1\frac{1}{2}$ inches in height and so have to be transplanted while still very small and liable to cutworm attack. In the 1954-55 season, over 10 per cent. of the seedlings were destroyed within 24 hours of planting. As a precaution against similar damage in

the 1955-56 season, a 5 per cent. B.H.C. soil insecticide was dug in to a depth of about four inches in a circle 2—3 feet in diameter round each marker, giving a total dressing of about 30 lb. per acre. Immediately after planting, the whole area was enclosed by wire netting as a protection against hares.

These precautions were effective, for in a progeny trial planted in December, 1955, the stand was still 98·5 per cent. by the middle of July, in spite of a long period of exceptionally hot, dry weather in January and February. If this rate of survival can be maintained, it should be possible to reduce the number of trees and to increase the the number of progenies tested without greatly impairing the accuracy of comparison or increasing the area of land used.

Progeny trial, 1955-56. The open-pollinated progenies of 49 selected trees are being compared in a 7 × 7 balanced lattice square with four replications. Transplanting to the field took place on 6th December, 1955, and seven months later, measurements of height showed significant differences between families.

Gummosis and black-butt in progeny trials. The incidence of gummosis and black-butt has now been recorded in four of the older progeny trials, and in all four, differences significant at the one per cent. level have occurred between families. Evidently, a well marked resistance to these diseases is carried by some of the parent trees. The results are summarized very briefly below.

Trial number	Age at scoring years	Gummosis %		Black-butt %	
		Range between families	Mean of trial	Range between families	Mean of trial
1	4·5	47·7—88·0	70·4	33·0—70·9	57·3
2	3·5	31·0—74·4	58·9	1·2—32·0	17·8
3	2·5	15·4—49·0	33·6	3·2—22·7	10·9
4	1·5	11·1—65·7	33·0	Negligible	

On individual trees, gummosis was scored as being light, medium, or heavy, but the interim analysis of the data was confined to infected or non-infected trees, irrespective of degree of infection. Thus, a tree with a single globule of gum was counted as being infected, although such a mild attack might prove to be harmless. Families with the highest percentage of gummosed trees almost invariably had the heaviest and most damaging attack on individual trees. If, therefore, the degree of gummosis had been taken into account, the differences between susceptible and partially resistant trees would have been even greater.

The incidence of black-butt was more difficult to analyse since this disease is associated to some extent with gummosis (Annual Report, 1954-55). In the first and second trials, however, significant differences in the degree of infection occurred, giving evidence of genetic variability for the incidence of this disease.

The relationship between gummosis and vigour was studied. General observations and silvicultural experiments have produced some evidence that where vigour is increased by cultural methods, a corresponding increase in the incidence of gummosis occurs. All four progeny trials scored for gummosis also showed significant differences in vigour and the data were examined to determine whether the families having the highest incidence of gummosis were also the most vigorous. There was, however, no indication of correlation between vigour and gummosis. Evidently induced vigour behaves differently from inherent vigour in this respect.

4. Vegetative Propagation.

Air-layers for the rooting of cuttings were placed on 81 trees selected during December for progeny testing. Although the majority of these trees will be discarded when the results of their progeny tests are known, the policy has been adopted of propagating all

selected trees as soon as possible because of the danger of accidental loss and the difficulty in propagating older trees.

5. Tetraploidy.

A rough comparison of diameter and bark thickness was made between a number of three-year old diploid and tetraploid trees growing intermingled in the same plantation. The tetraploid trees were from open-pollinated seed of the original colchicine treated trees which were growing rather widely dispersed amongst diploids. From the segregation of seedling characters and the appearance of many recessive types at a later stage, there is reason to believe that the tetraploid families are, in fact, largely the result of self-fertilization rather than cross-pollination. Because of the number of these abnormal types, only the best tetraploid trees were selected for comparison with the best diploids.

The 42 tetraploid trees measured had a mean diameter of $3{\cdot}80 \pm 0{\cdot}472$ inches and a bark thickness of $5{\cdot}51 \pm 0{\cdot}887$ mm., while the 29 diploids gave a mean diameter of $4{\cdot}75 \pm 0{\cdot}859$ inches and a bark thickness of $5{\cdot}42 \pm 0{\cdot}870$.

The tetraploids were, therefore, on the whole less vigorous than the diploids, but the possibility that this reduction in vigour was due partly to inbreeding cannot be ruled out. On the other hand, since there is a positive correlation between diameter and bark thickness, the tetraploid bark was relatively thicker than that of the diploids. If the relationship had been the same in the diploids, they would have had a bark thickness of 6·50 mm.

While these results are very inconclusive, there is a growing volume of data which show that tetraploids do, in fact, have a relatively thicker bark than diploids. It is also evident, however, that a considerable amount of selection must be practised before there is any possibility of producing tetraploid lines of economic value. With this end in view, a number of the best tetraploid trees are being propagated by cuttings so that they may be brought together for cross-pollination.

An experiment was started to determine the optimum percentage of colchicine for treating four different species of Acacia, viz. *A. mollissima*, *A. decurrens*, *A. dealbata*, and *A. baileyana*, and the proportion of tetraploids which could be expected. Unfortunately, a number of the seedlings were accidentally destroyed and it has not been possible to get a good estimate of proportions, but tetraploids have been obtained in all four species.

(c) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.* In earlier reports, the effects of treatment have been assessed on the basis of mean tree height. As the trees grow older, annual height increase is reduced and bark increment becomes a function of height and girth. The results this year have been calculated on the basis of estimated bark weight, taking into account both height and diameter. The results are, however, presented in the same way as in previous reports, with No Treatment=100, so that when phosphorus is quoted at 118 it means that application of superphosphate gave an 18 per cent. increase in yield.

Mean bark weight in relation to treatment
(No Treatment=100)

Soil-parent material	Nitrogen	Phosphorus	Potash	Lime
Table Mountain sandstone..	98	118*	105	108*
Shale	99	113*	110*	107*
Dolerite	102	112*	99	109*

* Differences significant (P=0·01)

As before, phosphate is shown to be beneficial on all sites; potash also shows improvement on shale. The main interest of the results lies in the effect of lime, which, for the first time, is significantly beneficial on all sites. This delayed-action effect was first noted on Table Mountain sandstone when the trees were in their sixth year and the same effect is now also apparent on the other soil types. It will be interesting to see if this is maintained until harvest.

(*b*) *Different forms of phosphate.* Earlier measurements, based on height, in the experiments laid down to compare different forms of phosphatic fertilizer showed that only those containing superphosphate had a good effect. This year, using estimated bark weight, there are no significant differences between treatments, which might mean that the less soluble forms are beginning to have some effect.

Bark weight in relation to phosphate
(Mean=100)

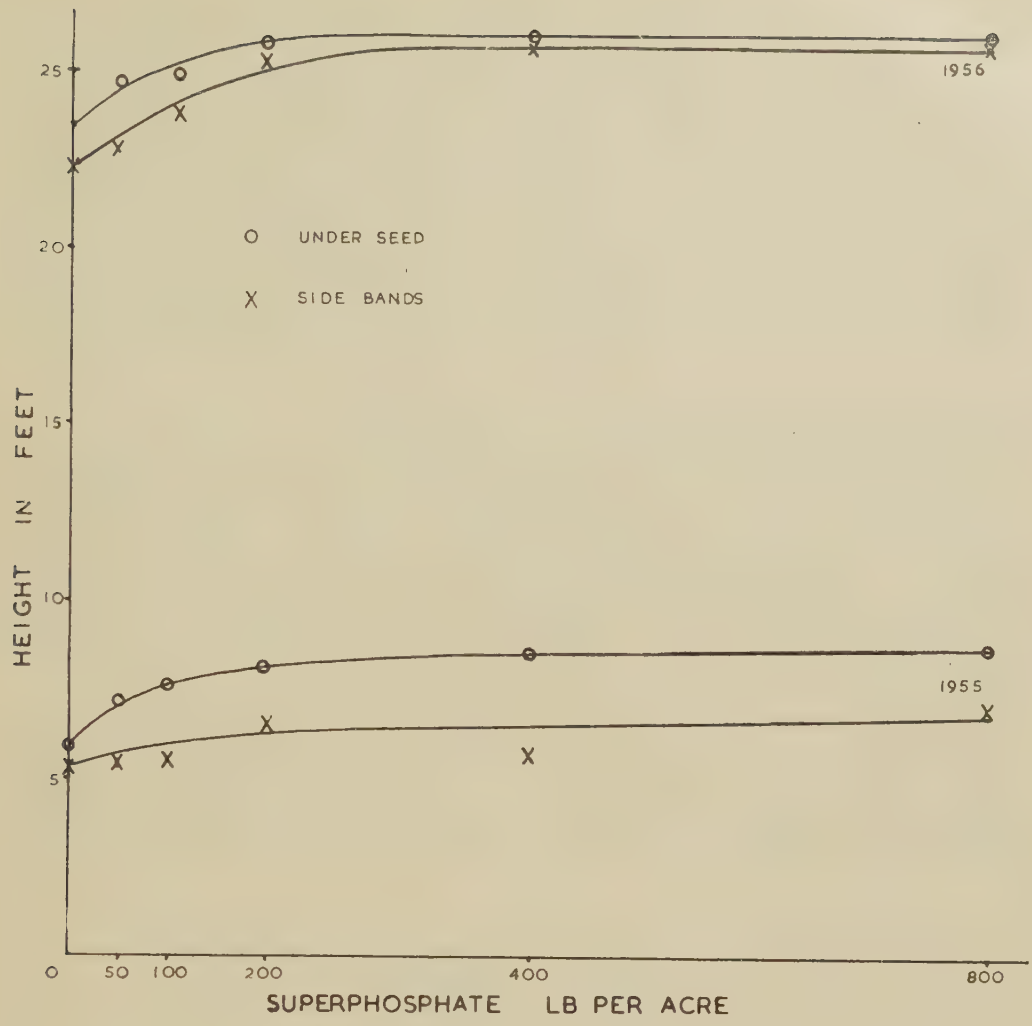
Treatment	On dolerite	On shale
Superphosphate	103	104
Super-raw (3 : 1)	99	103
Langfos	98	98
Moroccan rock	99	97
Calcium metaphosphate ..	100	98

(*c*) *Quantity of superphosphate and method of application.* There has also been a change in the indications of the results of the experiment comparing different methods and amounts of application of superphosphate. From early measurements, it seemed preferable to apply all the fertilizer under the seed before sowing (Treatment C), but this year, there are no significant differences between methods. In other words, if it is not convenient to apply the fertilizer under the seed, then application in side bands at first thinning (Treatment D) will give similar results. Equally, the dressing may be split, half the dose being applied under the seed (Treatment A) or at first thinning (Treatment B) with the other half in each case a year or so later. On the other hand, Treatments A and B have little to recommend them as the cost of application is doubled and there might be danger of root damage. The effects due to different dosages are still significant and the optimum economic application remains at about two cwt. per acre. The results of the latest measurement (in mean tree height in feet) are summarized below and illustrated in the graph which includes the previous findings for comparison.

Treatment	Superphosphate lb./acre						
	0	50	100	200	400	800	Mean
A	23·85	25·00	24·68	25·65	25·28	25·90	25·08
B	22·60	22·73	24·08	23·55	25·20	25·10	23·88
C	23·33	24·60	24·85	25·83	26·05	26·13	25·13
D	22·40	22·75	23·73	25·40	24·90	26·03	24·20
Mean	23·05	23·77	24·34	25·11	25·36	25·79	24·60

	Treatment	*Amount*
Standard error	0·495	0·247
Significant difference (P=0·01)	1·61	0·66

(*d*) *Incidence of gummosis.* Once more, counts of affected trees on all the fertilizer experiments have revealed no significant differences.



2. Bark Analysis.

(*a*) *Routine analysis.* Nearly 800 bark samples were analysed during the year, including 89 samples submitted by the Government Inspector of Wattle Bark. Once again, the visual grading method agreed generally with analytical results, but discrepancies sometimes occur when the grader is dealing with unfamiliar growths in which the actual tannin content does not conform with appearance. Thus, bark from the Cape may be misjudged until more experience of samples from that area has been obtained.

(*b*) *Tree and plot sampling.* In the continuation of work on this problem, over 50 trees were stripped in three-foot sleeves. Each tree was marked at three feet from the base and the bark stripped and weighed immediately. Then the tree was felled and successive three-foot sleeves were taken off, weighed in order, and kept separate for further weighings in the course of drying. It was found that about half the total bark of a tree came from the basal third of its height. As the basal bark normally contains more tannin than that from the upper portion, it was decided to try to work out a stratified random sampling technique whereby roughly equal weights of sample from

the bottom third and the upper two-thirds of the tree could be combined to provide a representative tree sample. Before this could be tried out on a practical scale, it was necessary to devise means of obtaining standard reference samples of bark from tree or plot with which to compare samples obtained by other techniques. To this end, a special delivery trunk, fitting a standard ensilage cutter, was designed with an adjustable baffle at the open end in order to take a running sample of bark as it was being chipped. The proportion of sample to total bark could be adjusted by moving the baffle at the beginning of a run. The equipment was tried out on the bark harvested from 27 plots in a silvicultural experiment and also from an eight-plot entomological experiment. In each case, the reference machine sample was compared with four sets of pellet samples taken in the field as the plots were being harvested. The results obtained to date are promising, but it is clear that much more work is needed before this problem can be solved.

3. Seasonal Effects on Extractives in Wattle Bark.

(*a*) *Variation in non-tan content.* Analyses of samples taken fortnightly in the course of this work for the first two years show a fall in non-tan content and a consequent rise in the ratio of tan to non-tan during the summer months. There is a significant correlation with rainfall, but it is not yet certain that this is the only factor involved. The issue is rather confused by the variation from tree to tree, an indication that plot size must be increased or that the work must be repeated using clonal material. Another possible line of attack is to sample the same trees each time without unduly damaging the trees. This possibility is largely dependent on the results of the sampling techniques discussed in the previous section. In the meantime, a small irrigation experiment is being conducted to obtain further information as an aid to designing a more conclusive experiment later.

(*b*) *Moisture content of bark at stripping.* Whenever possible during the stripping operations described above, various pellet samples of bark were taken in tared weighing bottles, weighed, dried, and weighed again in order to find a sampling method for moisture content. It was found that a single, random, pellet sample per tree was sufficient to give a reliable estimate.

(d) ENTOMOLOGY

1. Bionomy of Wattle Bagworm.

Biotic potential. Data were obtained from 76,798 bagworms for the determination of sex ratio and factor, and from 22 females for the average number of eggs. It was found that the overall sex ratio was 1 female to 1·4 males and the sex factor 0·42. The proportion of males increased somewhat in plantations where the infestation was on the up-grade. The number of eggs per female averaged 1,180. The annual biotic potential was 495, while the biotic balance amounted to 99·8 per cent.

2. Effect of Bagworm Attack on Increment.

Increment plots laid out in seven different plantations were checked at the end of 1955 and again examined and measured in co-operation with the Silviculture Section during June and July, 1956.

3. Chemical Control.

(*a*) *Small-scale experiment.* A small-scale, replicated, spraying experiment was carried out to test the efficacy of four different insecticides against bagworms in both earlier and later instars. An account of this experiment is given on page 42 of this Report.

(*b*) *Aerial spraying experiment.* A replicated experiment was laid down over an area of approximately 300 acres in preparation for testing in the 1956 season the effect of Toxaphene and Endrin in diesel oil sprayed from the air on bagworms up to the third instar and on other wattle insects.

(*c*) *Commercial spraying campaign, 1955-56.* Approximately 15,000 acres were surveyed for this campaign. Nearly 8,000 acres were selected for treatment, and on these latter, the application was supervised. In all, 12,137 acres were sprayed, of which over 600 acres had to be re-treated. The insecticide used was Toxaphene in light diesel oil at 1 lb. per gallon of solution applied at the rate of 3 gallons per acre in older plantations and 2 gallons per acre in younger ones and in such mature stands as needed treatment to facilitate stripping. The campaign started on the 29th October and, excluding the correctional spraying, was finished on the 17th December, 1955, while the correctional applications were concluded on the 28th January, 1956.

This campaign has confirmed that, if organized properly and the treatment carried out efficiently under favourable weather conditions, fairly satisfactory results can be obtained in some categories of plantations, but only in terms of a single season. It has also proved that an aerial application cannot stop bagworm infestation from spreading. Where the infestation is on the up-grade, the cycle is interrupted and the peak delayed for one or more years. Inefficient spraying, where strips and corners are missed and where an inadequate cover is obtained, is responsible for the carry-over of infestations from season to season. If, in the season following treatment, wattles in these badly sprayed plantations flush when the bagworms are hatching, these plantations become heavily infested from internal sources. If, however, flushing and hatching do not synchronize, the bagworms usually move to younger, neighbouring stands and infest them.

During this campaign, further studies were carried out and data collected on the influence of the insecticide on other wattle insects. The technique of spraying was also studied.

(*d*) *Commercial spraying campaigns, 1952, 1953, and 1954.* The study of the effect of these campaigns on wattle plantations and the cycle of bagworm infestations was continued.

4. Biological Control.

Virus disease in bagworms. Small-scale, replicated experiments were conducted with aqueous, virus suspensions at various concentrations. Artificial infection by suspensions of 10,000 polyhedra per $mm.^3$, applied to trees at the time of hatching of larvae, caused a very high mortality, which was not significantly increased when higher concentrations were used. The first signs of newly-hatched larvae being infected with virus appeared three to four days after feeding on contaminated food, and death occurred two days later. When the suspension was applied at a later stage of development of the larvae, death was slower, but the mortality was still high enough to prevent serious defoliation of the infested trees. The polyhedra remained infective for a considerable time out-of-doors, suggesting the possibility of application before the larvae emerge. Once disseminated in the field, they were not washed off even by heavy rains, and they appeared also to have no adverse effect on the parasites of the bagworm. A paper on these experiments has been accepted for publication (Ossowski, 1957).

5. Study of the Genus Acanthopsyche.

The study of this genus, with special reference to *A. junodi* Heyl., has now been completed. It was found that the genotype of *Acanthopsyche* is the palaearctic species *Psyche opacella* H.S., which is a synonym of *Phalaena atra* Linn., 1776. Since *junodi* is an indigenous insect of the Ethiopian Realm, it cannot remain in the palaearctic genus *Acanthopsyche*, and it is proposed to place it in the genus *Kotochalia* within a new subgenus *Chaliella*.

A paper on this subject, written in conjunction with Dr. J. G. Betrem, of the Institute of Tropical Agriculture, Deventer, Netherlands, has been accepted for publication (Betrem & Ossowski, 1957).

6. Study of the Life Cycle of Parasites of Bagworms.

The study of the life cycle of *Philopsyche abdominalis* Morley has been completed and a paper containing the findings has been accepted for publication (Smithers, 1956).

7. Identification of Insects.

(*a*) *Associated with wattle.* Eight insect species so far not recorded as potential wattle pests were observed damaging plantations and were identified. Further details of these insects are given on page 37 of this Report.

(*b*) *Not associated with wattle.* Beetles doing extensive damage to felled pines in the Albert Falls area were identified as *Xyloborus xylographus* Say. (Scolytidae).

8. Records of Insect Outbreaks.

These records at present contain data concerning 46 species on over 200 farms and plantations.

9. Wattle Insect Collection.

This collection of wattle insects, started in 1953, now contains nearly 200 species.

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(e) MISCELLANEOUS

1. Weed Control by Chemical Means.

After a number of unsuccessful attempts to eliminate a stand of aspen (*Populus tremula*), a promising method has now been discovered. By spraying the basal two feet to wetness with a solution of a 2:4:5-T ester in diesel oil, individual trees up to three inches diameter were killed. It remains now to work out a satisfactory technique for treating a large area of densely packed stems.

The abnormally dry weather during January and February, during which seed germination was generally poor and irregular, made it necessary to defer the projected further experiments on pre-emergence weed control.

2. Collaboration with other Organizations.

(*a*) *Studies on the tannins of wattle species.* Samples of shoots, leaves, wood, and roots of both black and green wattle were collected for the Leather Industries Research Institute for comparison of the tannins in the various parts.

(*b*) *Composition of wattle wood.* To assist in the investigations on wattle timber recently resumed in the National Chemical Research Laboratory, 40 wood samples from selected trees were sent to the Laboratory in May. These are to be used in an examination of the carbohydrates with a view ultimately to obtaining more information about the suitability of wattle wood as a source of rayon pulp.

(*c*) *Utilization of wattle gum.* A sample of gum was collected and sent to the Centraal Instituut voor de Dropverwerkende Industrie, Amsterdam, for examination of its possible use in food and confectionery.

PROGRESS REPORTS AND PAPERS

THE CONTRIBUTION OF THE SOUTH AFRICAN WATTLE GROWERS' UNION TO RESEARCH ON WATTLE*

By H. SHAW

Individual wattle growers have long been conscious of the need for scientific research to keep their industry in the forefront of current progress. Even among the earliest of the pioneers, there were a few who were very much alive to the benefits to be derived from progressive methods and who were not prepared to accept their failures as heaven-decreed dispensations. Always they sought to analyse and improve.

It is well-known that the black wattle became established in South Africa almost by chance, and certainly with no intention of starting a new industry. Perhaps the first piece of research to be carried out was in 1884 when, at the instigation of Mr. G. M. (later Sir George) Sutton, Lyle's Tannery in Pietermaritzburg investigated the tanning properties of both black and silver wattle bark grown in Natal. Sutton himself carried out many silvicultural experiments and some of the practices adopted as a result can scarcely be improved upon today.

It is not surprising, therefore, that when the South African Wattle Growers' Union was re-formed in March, 1938, it immediately set up a Research and Technical Committee comprising several progressive wattle growers together with government and other technical officers located in and around Pietermaritzburg. One of the first tasks of this Committee was to consider the widespread incidence of gummosis, a disease of wattle causing serious reduction in the quality of the bark. Representations were made to the Department of Agriculture for the appointment of an officer to survey the whole field of wattle pathology and as a direct result, a pathologist was appointed in November, 1938, for an initial period of three months to report on the problem of gummosis. The outcome of this survey was such as to lead the Union, at its Congress in March, 1939, to press for the retention of this officer's services; the Department in reply suggested that the matter might be facilitated if the Union were prepared to subsidise the officer's salary to the extent of £200 per annum.

Meantime, at a Special Congress in November, 1938, the Union had established a "Pest Eradication Fund" financed by a contribution of two shillings per ton on all exports of wattle extract and one shilling per ton on exports of wattle bark. This was equivalent to a deduction from growers' prices of one shilling per ton on dry bark and sixpence per ton on green. It was from the resources which thus became available that the Union was able to vote in March, 1939, the funds necessary to ensure continuation of the work of the plant pathologist. Thus arose the first direct financial contribution from the Wattle Growers' Union in support of research.

The next, and for some years the major, contribution from the Union towards research came with the establishment of the Leather Industries Research Institute at Grahamstown in 1941. In July of that year, following discussion with the Director of the Institute, the Union entered into an agreement to contribute £1,000 per annum for

* Reprinted from *Wattle Tannin and Mimosa Extract* by kind permission of the Leather Industries Research Institute, Grahamstown.

an initial period of three years. This grant, subsequently increased to £1,250 per annum* and augmented on a £ for £ basis by the Council for Scientific and Industrial Research, has been a major factor in facilitating the investigations on the nature and use of wattle tannin which have constituted one of the Institute's principal and most successful activities. The remainder of this volume is in the main devoted to a description of this work.

Not content with these substantial contributions to encourage research, the Union in 1942 voted £800 per annum to assist the Department of Agriculture and Forestry in providing a geneticist to work on wattle. A research officer was appointed in December, 1942, and proceeded to set up a Wattle Genetics Research Station on 100 acres of land leased from the Pietermaritzburg Corporation. Here a series of trials was started to compare the performance of black and green wattle and a number of hybrids, as well as selected individual trees.

All this, however, did not satisfy the now thoroughly research-minded Wattle Growers' Union. Somewhere about 1937, a number of growers, under the stimulus of discussions with the Research Officers of the Department of Forestry, had begun to take an interest in the idea of a Wattle Research Institute. It was felt that the importance of the industry merited the establishment of a research organization devoted exclusively to the improvement of wattle cultivation and tannin production and into which all the various lines of research on wattle could be gathered as a co-ordinated whole.

The results of the work of the plant pathologist appointed in 1938 at the instigation and with the financial support of the Union brought home to the general body of growers the need for and value of research in the industry. Consequently, when a resolution was moved at the 1940 Congress urging the Government to establish a Wattle Research Institute, ready support was forthcoming. The Government, however, while sympathetic towards these representations, indicated that the matter could not be decided in the war-time conditions then prevailing. The Minister of Agriculture and Forestry suggested that in the meantime a scheme should be prepared in which the Wattle Growers' Union would set up an Institute with the assistance of a government subsidy.

To give effect to this suggestion, the Union appointed a Research Institute Sub-committee in 1941. Draft plans were prepared and definite financial proposals were made to the Government. Again, however, a decision was deferred and the Minister suggested that a Research Fund should be built up pending the return of more propitious times.

The opening of the Genetics Research Station served only to stimulate the Union to further efforts. At its Congress in 1943, the decision was reached to establish a Research Department within the Union and to appoint a Director of Research "to investigate and deal with the early establishment of a Research Institute". The Government's wattle genetics officer was appointed to this post, at the same time retaining the general oversight of the Wattle Genetics Station which remained in the immediate charge of a research officer of the Department of Agriculture and Forestry.

The Congress of 1944 took another major step in setting aside £30,000 towards the cost of building an Institute and maintaining it in its early years. A Research Board was set up and power to vote further annual sums was conferred upon the General Committee, which was also authorized to double the contribution from bark and extract exports as soon as the need might arise.

After lengthy discussions, agreement was reached early in 1946 on a scheme wherein responsibility for the Institute was to be shared by the South African Wattle Growers' Union, the University of Natal, and the Union Government Department of Forestry. A site was allocated on the University campus and the Department of Education made a grant of £10,000 towards the £25,000 initial cost of the building, the balance being provided by the Wattle Growers' Union. The Institute was formally inaugurated as

* Again increased in 1956 to £2,500 per annum, with £ for £ subsidy,

from the 1st May, 1947, the date of the appointment of its first Director, though it did not effectively start operations until the following year.

The Institute is responsible ultimately to the University Council, but has its own Committee of Control representative of the three sponsoring bodies. The Government, through the Department of Forestry, contributes a flat rate of £5,000 per annum towards running costs, the balance, currently amounting to some £20,000, being borne by the Wattle Growers' Union. The present establishment of the Institute comprises ten graduate research workers, with seven technical assistants and the necessary administrative staff. All the investigations previously conducted by Government officers have been taken over with the exception of Entomology. In terms of this arrangement, the Division of Entomology in the Department of Agriculture has continued to work on the insect pests of wattle, but the demands upon its available staff are so great that in 1949, the Institute set up its own Entomology Section, thus completing the range of subjects covered.

The laboratories proper comprise over 4,000 square feet of floor space in thirteen separate rooms fitted out and equipped on modern lines. There is also a spacious library and a number of ancillary rooms and offices. An outdoor insectary has been built for entomological work and a small nursery has been established adjacent to the Institute building. Early in 1950, a 670-acre farm just outside Pietermaritzburg was purchased by the Wattle Growers' Union at a cost of about £18,000 and placed at the disposal of the Institute for use as a Field Experiment Station. The Institute is thus adequately equipped to undertake a comprehensive programme of research involving both field and laboratory investigations.

The work at present in progress is organized in various Sections, namely Silviculture, Genetics and Plant Breeding, Soils and Fertilizers, Chemistry, and Entomology. From this it will be clear that the Institute is primarily concerned with the agricultural side of the wattle industry and, indeed, with the exception of certain chemical analytical problems, is not directly concerned with either wattle bark or wattle timber once these have left the plantation and become industrial raw materials. This is a very convenient division of spheres of activity, for it is precisely at this point that the Leather Industries Research Institute takes up the bark as a tanning medium. The work of the Wattle Research Institute in the above-named sections can be summarized briefly as follows.

The Silviculture Section is carrying out research on general cultural methods in wattle growing, including thinning, pruning, weed control, brushwood disposal, and re-establishment. Studies on growth and yield and on the incidence and control of disease are also in progress. Fundamental investigations on environmental influences and on the effects of cultural practices on soil condition and plant growth complete the programme.

In the Genetics and Plant Breeding Section, the main lines of work are the genetical analysis and hybridization of wattle species, selection for characters of economic importance, vegetative propagation, and the study of induced polyploidy and pollination mechanism.

Soils and Fertilizers is concerned with general fertility problems, the fertilizer requirements of wattle, fertilizers in relation to the incidence of disease, and soil structure, etc. in relation to tree performance.

In the Chemistry Section, problems of wattle bark sampling and commercial analysis are being investigated and a new field on the biochemistry of tannin formation is being opened up with particular reference to differences between species.

The work of the Entomology Section comprises a comprehensive study of the fauna, noxious and otherwise, of wattle. Chief problems are the biology, economic significance, and chemical and biological control of the wattle bagworm and froghopper.

It will be apparent that many of the above studies merge into each other and, in fact, are joint investigations between different Sections. Here the advantages of an Institute working as a co-ordinated team on a single group of associated problems are clearly

evident. The Wattle Research Institute, both by reason of its own resources and by its very close association and co-operation with growers, is particularly well-placed to pursue these investigations to a satisfactory conclusion, though from the very nature of the crop, many of them are inevitably of a long-term nature.

The most recent venture into research by the Wattle Growers' Union was the institution in the middle of 1955 of a Wattle Timber Research Fellowship of £2,000 per annum at the National Chemical Research Laboratory of the South African Council for Scientific and Industrial Research. By this means, the fundamental properties and practical uses of wattle wood are to be investigated.

This brief account of the active participation of the South African Wattle Growers' Union in research constitutes a most praiseworthy record of vision and enterprise and of belief in and practical support for scientific investigation as a necessary basis for a progressive industry. It must be said, too, that the Union has never taken the short and narrow view that only research of immediate and practical value is worthwhile; it has always been ready to support long range fundamental investigations, a fact which is greatly to the advantage of both the Leather Industries Research Institute and the Wattle Research Institute.

THE BLACK AND GREEN WATTLE PROGENY TRIALS AT SWEETWATERS

By A. A. MOFFETT

An account is given of the first replicated progeny trials to be carried out with black and green wattle. The characters for which the parent trees were selected did not appear consistently in their progeny due, probably, to the high degree of cross-pollination found to occur in wattle. In black wattle, a fairly good estimate of the final relative vigour of the families could be made when the trees were two years old, but in green wattle, measurements of young trees were less reliable in forecasting the final results.

Introduction.

The progeny trials described in this Report were started in 1943 by Dr. J. Philp and Mr. S. P. Sherry, who were then on the staff of the Union Government Department of Forestry.* The purpose of the experiments was to determine to what extent the characters of a tree are passed on to its offspring and to record any differences in growth rate between families. With this end in view, a number of trees of both black wattle (*Acacia mollissima*) and green wattle (*Acacia decurrens*) which showed diverse characters were selected as parents and open-pollinated seed was collected from them. At this time, it was not known whether wattle was mainly self- or cross-pollinated. During the first few years of the growth of the trees, frequent records were made of height, diameter, and other individual characteristics. When, however, wattle research was re-organized in 1947, these records were discontinued and, unfortunately, the majority of the parent trees, which were growing on farms in various parts of the wattle area, were lost during the transition. Because of this and pressure of other work, no further records were made until the trees were felled and harvested in April, 1954. The experiments were, therefore, isolated units which could not be carried further, but as they have yielded valuable information on development and are of some historical interest in being the first replicated progeny trials in wattle, it is felt that the results should be put on record.

Experimental Details.

The black and green wattle trials were planned as two separate entities, but stood side by side on a block of land which was of fairly uniform soil type. Therefore, although no statistical comparisons can be made between the two species, it is probable that the more obvious differences are real and not due to soil conditions.

Eleven parent trees were selected from each species and in each trial, a family grown from commercial seed was included. Seed was sown directly in the field at what was to be the final espacement, i.e. 6 feet by 18 feet, giving 400 trees per acre. Several seeds were sown at each spot, the seedlings subsequently being singled at random except that in two families, plots thinned with selection for the most vigorous seedlings were included in addition. These plots are marked by an "S" in the following tables. There were, therefore, fourteen families in each species and these were grown in a randomized block layout with six replications, each plot consisting of fifteen trees. Subsequently, one of the parent trees in the green wattle trial proved to be a hybrid; the results from this family have been omitted from the tables.

The sowing dates for black and green wattle respectively were the 12th and 17th of March, 1943. In a number of spots where germination failed or was poor, seedlings were transplanted from spots where there was an excess in the same family. These transplants inevitably suffered a set-back and they have been omitted from the tables of height and

* The planning and establishment of the experiments and all records up to 1947 were entirely due to Dr. Philp and Mr. Sherry. All figures given in the tables for the earlier stages of the experiments were drawn from these records, but the interpretation of the results and the views expressed are the responsibility of the author.

diameter up to 1947. By the time of felling in April, 1954, however, there was so little difference between the transplants and non-transplants that both have been included in the results.

The characters selected in the parent trees were vigour, bark and stem appearance, branching habit, and gummosis. These characters are listed in Tables I and II.

Characters of the Parents in the Offspring.

In both species, the bark and branching characteristics for which the parent trees were selected do not appear to be passed on to the progeny. Either the characters did not appear at all or, if they did appear, it was with a frequency equal to that in families whose parents did not show the particular character. It must be assumed either that these characters were not inherited or, as appears more likely, that they were recessive and were obscured by the general cross-pollination occurring in wattle.

The progeny of the black wattle tree No. 6, which was heavily gummosed, showed no greater susceptibility to gummosis than some of the other families whose parents showed no signs of the disease. The mean percentage gummosed trees in black wattle was 6·1, with a range of 0 to 13 per cent., while in the progeny of tree No. 6, 5·3 per cent. of the trees were attacked.

There was a suggestion that in black wattle, vigorous parents produced vigorous offspring and suppressed parents progeny below average, but this indication may have been purely fortuitous. In more recent trials, it has not been possible, so far, to establish any relationship between the vigour of a parent tree and that of its offspring. Furthermore, in the green wattle trial, there was no indication of a positive correlation between the vigour of the parent and that of its offspring. As can be seen from Table IV, families from above-average trees were amongst the lowest in vigour at harvest, while progenies from suppressed or average trees were amongst the best.

Comparative Growth Rates of Progenies.

Records made at three-monthly intervals during the first 4½ years growth in both trials, combined with the results at harvest, have given valuable information as to the stage at which it is possible to assess the relative vigour of the families with some degree of confidence. Height and diameter have been used as measures of vigour and these are shown in six-monthly intervals in Tables I—IV. In order to show the relative differences on the same scale throughout, the figures for each family are also given as a percentage of the mean or average for each trial. The first height measurements given in the tables were taken approximately eight months after sowing and the first diameters when the trees were almost exactly two years old.

In black wattle, differences between the progenies which were evident when the trees averaged only one foot in height already gave some indication of the relative heights of the families when they were felled some ten years later (Table I). Height, however, has not proved to be a very satisfactory measure of vigour, more especially after competition for light has set in. Trees tend to grow to approximately the same height irrespective of their diameter, and early differences decrease. Thus, in both black and green wattle trials, height differences were significant when the families were young, but at harvest there was no significant difference in either species.

Diameter, on the whole, proved to be a more stable measure of vigour. In black wattle, diameters measured in 1945, when the trees were two years old, gave a remarkably accurate forecast of the relative diameters at time of felling (Table III). More recent experiments all seem to be supporting this finding.

In green wattle, the result was somewhat different. The relative positions of the families at the first height measurement bore little relationship to their positions at the time of felling (Table II), but by 1945, the families had fallen more or less into the positions they occupied at harvest. Here again, there was a tendency for height differences to disappear as the trees got older, and by harvesting time, there were no significant differences between the families.

TABLE I

Black wattle. Height in feet and as percentage of the mean

Family number	Parent tree	Nov., 1943		Jan., 1944		July, 1944		Jan., 1945		July, 1945		Jan., 1946		July, 1946		Jan., 1947		July, 1947		April, 1954	
		Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%
1	Vigorous ..	0·8	93·0	1·9	88·8	7·6	100·9	14·5	101·3	21·1	104·2	26·2	103·8	31·0	104·2	35·4	104·5	39·7	103·5	62·2	104·2
1S	Vigorous ..	0·8	93·0	2·2	102·8	8·7	115·5	15·8	110·3	21·8	107·6	27·3	108·2	31·9	107·2	36·7	108·3	41·8	109·0	62·9	105·4
3	Suppressed ..	0·9	104·6	2·2	102·8	7·5	99·6	14·3	99·9	20·3	100·2	25·7	101·8	30·1	101·1	35·3	104·2	39·7	103·5	60·0	100·5
3S	Suppressed ..	0·9	104·6	2·3	107·5	7·7	102·3	14·6	102·0	20·2	99·7	25·8	102·2	30·0	100·8	34·7	102·4	38·4	100·1	59·5	99·7
5	Dimpled stem	0·7	81·4	1·8	84·1	7·0	93·0	13·2	92·2	19·1	94·3	23·7	93·9	27·8	93·4	31·4	92·6	35·5	92·5	54·7	91·6
6	Gummosed ..	1·2	139·5	2·9	135·5	8·7	115·5	15·4	107·5	21·4	105·6	26·4	104·6	31·3	105·2	36·3	107·1	40·2	104·8	61·3	102·7
7	V. rough bark	0·9	104·6	2·2	102·8	7·8	103·6	14·1	98·5	20·1	99·2	24·8	98·3	29·5	99·1	33·4	98·6	38·3	99·8	61·6	103·2
10	Heavily branched..	1·0	116·3	2·4	112·2	8·0	106·2	15·1	105·4	20·7	102·2	24·4	96·7	29·3	98·4	33·6	99·1	38·6	100·6	59·6	99·8
11	Suppressed ..	0·7	81·4	1·8	84·1	7·1	94·3	13·7	95·7	19·9	98·2	25·1	99·4	29·9	100·5	34·0	100·3	38·8	101·2	57·4	96·2
12	V. rough bark	1·1	127·9	2·5	116·8	7·4	98·3	13·7	95·7	19·9	98·2	24·4	96·7	28·5	95·8	32·0	94·4	36·2	94·4	59·6	99·8
13	Wrinkled bark	0·9	104·6	2·2	102·8	8·0	102·2	16·1	112·4	20·8	102·7	26·0	103·0	30·6	102·8	35·2	103·9	39·5	103·0	62·7	105·0
14	Fluted stem	0·8	93·0	1·9	88·8	7·0	93·0	13·4	93·6	19·4	95·8	24·2	95·9	28·7	96·4	32·1	94·7	36·2	94·4	61·2	102·5
16	V. rough bark	0·5	58·1	1·6	74·8	6·3	83·7	12·8	89·4	19·1	94·3	24·6	97·5	28·8	96·8	31·9	94·1	36·1	94·1	53·5	89·6
C	Commercial seed	0·8	93·0	2·1	98·1	6·7	89·0	13·8	96·4	19·9	98·2	24·8	98·3	29·2	98·1	32·4	95·6	38·0	99·1	60·0	100·5
	Mean	0·86		2·1		7·5		14·3		20·3		25·2		29·8		33·9		38·4		59·7	

TABLE II

Green wattle. Height in feet and as percentage of the mean

Family number	Parent tree	Nov., 1943		Jan., 1944		July, 1944		Jan., 1945		July, 1945		Jan., 1946		July, 1946		Jan., 1947		July, 1947		April, 1954	
		Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%	Ht.	%
G2	Fluted stem	0·13	86·7	1·1	84·6	4·6	83·5	9·8	85·1	16·6	84·1	20·8	84·2	25·4	86·2	28·8	87·4	32·6	89·0	58·7	97·8
G3	Horizontal branches ..	0·18	120·0	1·6	123·1	6·2	112·5	12·7	110·3	21·1	106·9	26·5	107·2	30·9	104·8	34·4	104·4	38·1	104·0	59·5	99·2
G4	Dimpled stem	0·18	120·0	1·5	115·4	6·6	119·8	13·5	117·3	22·4	113·5	27·0	110·1	32·5	110·3	35·7	108·4	39·3	107·3	60·5	100·8
G5	Sinuous stem	0·13	86·7	1·2	92·3	5·2	94·4	10·8	93·8	18·9	95·7	23·4	94·7	27·9	94·7	32·6	98·9	34·8	95·0	57·8	96·3
G6	Heavily branched..	0·16	106·7	1·2	92·3	5·0	90·7	10·2	88·6	18·2	92·2	23·0	93·1	28·0	95·0	31·5	95·6	35·5	96·9	59·5	99·2
G7	Dimpled stem	0·14	93·3	1·3	100·0	4·9	88·9	10·4	90·4	18·3	92·7	23·2	93·9	27·9	94·7	31·7	96·2	35·4	96·6	61·4	102·3
G8	Suppressed ..	0·13	86·7	1·3	100·0	5·7	103·4	12·2	106·0	21·2	107·4	27·1	109·7	32·2	109·3	35·8	108·6	40·1	109·5	62·6	104·3
G8S	Suppressed ..	0·09	60·0	1·0	76·9	5·6	101·6	12·3	106·9	21·2	107·4	26·2	106·0	31·2	105·9	34·3	104·1	38·2	104·3	60·9	101·5
G13	Vigorous ..	0·14	93·3	1·3	100·0	5·6	101·6	11·9	103·4	20·1	101·8	25·1	101·6	30·0	101·8	33·5	101·7	37·1	101·3	61·3	102·2
G14	Green bark ..	0·15	100·0	1·5	115·4	5·7	103·4	10·8	93·8	19·0	96·2	23·7	95·9	28·0	95·0	32·0	97·1	35·5	96·9	58·1	96·8
G15	Vigorous ..	0·15	86·7	1·3	100·0	4·8	87·1	10·7	93·0	18·3	92·7	23·4	94·7	27·3	92·6	29·7	90·1	33·6	91·7	58·5	97·5
G15S	Vigorous ..	0·13	86·7	1·2	92·3	6·3	114·3	12·8	111·2	21·5	108·9	26·5	107·2	31·5	106·9	34·6	105·0	38·2	104·3	59·0	98·3
GC	Commercial seed	0·18	120·0	1·4	107·7	5·4	98·0	11·5	99·9	19·8	100·3	25·1	101·6	30·3	102·8	33·7	102·3	37·8	103·2	62·1	103·5
	Mean	0·15		1·3		5·5		11·5		19·7		24·7		29·5		33·0		36·6		60·0	

TABLE III

Black wattle. Diameter in inches and as percentage of the mean

Family number	March, 1945		July, 1945		Jan., 1946		July, 1946		Jan., 1947		July, 1947		April, 1954	
	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%
1	2·0	100·0	2·7	105·0	3·4	105·3	4·0	105·8	4·5	105·1	4·9	105·6	7·4	110·4
1S	2·1	105·0	2·7	105·0	3·4	105·3	4·0	105·8	4·5	105·1	4·9	105·6	7·4	110·4
3	2·0	100·0	2·6	101·2	3·2	99·1	3·8	100·5	4·2	98·1	4·6	99·1	6·3	94·0
3S	2·1	105·0	2·6	101·2	3·3	102·1	3·8	100·5	4·2	98·1	4·5	97·0	6·1	91·0
5	1·9	95·0	2·4	93·4	3·0	92·9	3·5	92·6	3·9	91·1	4·3	92·7	6·3	94·0
6	2·3	115·0	2·8	108·9	3·6	111·5	4·2	111·1	4·8	112·2	5·1	109·9	7·3	109·0
7	2·1	105·0	2·7	105·0	3·3	102·1	3·8	100·5	4·4	102·8	4·7	101·3	7·1	106·0
10	2·1	105·0	2·7	105·0	3·4	105·3	3·9	103·2	4·4	102·8	4·7	101·3	6·6	98·5
11	1·8	90·0	2·4	93·4	3·0	92·9	3·6	95·2	4·1	95·8	4·4	94·8	6·4	95·5
12	2·1	105·0	2·6	101·2	3·3	102·1	3·9	103·2	4·4	102·8	4·7	101·3	6·7	100·0
13	2·2	110·0	2·8	108·9	3·5	108·4	4·1	108·5	4·7	109·8	5·0	107·8	7·2	107·5
14	1·8	90·0	2·3	89·5	2·9	89·8	3·4	89·9	3·9	91·1	4·2	90·5	6·4	95·5
16	1·6	80·0	2·2	85·6	2·8	86·7	3·4	89·9	3·9	91·1	4·3	92·7	6·0	89·6
C	1·9	95·0	2·5	97·3	3·1	96·0	3·6	95·2	4·1	95·8	4·6	99·1	6·6	98·5
Mean	2·0		2·6		3·2		3·8		4·3		4·6		6·7	

TABLE IV

Green wattle. Diameter in inches and as percentage of the mean

Family number	March, 1945		July, 1945		Jan., 1946		July, 1946		Jan., 1947		July, 1947		April, 1954	
	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%	Diam.	%
G 2	1·0	83·3	1·8	85·7	2·2	81·5	2·7	84·4	3·1	86·1	3·5	89·7	6·0	98·4
G 3	1·5	125·0	2·4	114·3	2·9	107·4	3·3	103·1	3·7	102·8	3·9	100·0	5·8	95·1
G 4	1·4	116·7	2·3	109·5	3·0	111·1	3·4	106·2	3·8	105·6	4·1	105·1	6·0	98·4
G 5	1·2	100·0	2·0	95·2	2·7	100·0	3·1	96·9	3·6	100·0	3·9	100·0	6·1	100·0
G 6	1·1	91·7	2·0	95·2	2·6	96·3	3·1	96·9	3·5	97·2	3·9	100·0	6·4	104·9
G 7	1·1	91·7	2·1	100·0	2·6	96·3	3·1	96·9	3·5	97·2	3·9	100·0	6·5	106·6
G 8	1·3	108·3	2·2	104·8	2·8	103·7	3·3	103·1	3·7	102·8	4·0	102·6	6·2	101·6
G 8S	1·1	91·7	2·1	100·0	2·7	100·0	3·2	100·0	3·6	100·0	4·0	102·6	6·4	104·9
G13	1·2	100·0	2·1	100·0	2·7	100·0	3·2	100·0	3·5	97·2	3·8	97·4	5·8	95·1
G14	1·3	108·3	2·2	104·8	2·9	107·4	3·3	103·1	3·7	102·8	4·0	102·6	6·1	100·0
G15	1·3	108·3	2·0	95·2	2·5	92·6	2·9	90·6	3·2	88·9	3·5	89·7	5·6	91·8
G15S	1·2	100·0	2·2	104·8	2·8	103·7	3·3	103·1	3·7	102·8	4·0	102·6	5·9	96·7
GC	1·2	100·0	2·2	104·8	2·7	100·0	3·1	96·9	3·6	100·0	3·9	100·0	6·2	101·6
Mean	1·2		2·1		2·7		3·2		3·6		3·9		6·1	

Diameter showed even less correlation between early scoring and the final measurements in green wattle (Table IV) and even four years after sowing (July, 1947), it would not have been possible to forecast the relative positions of the families for mean diameter at felling.

In both species, plots selectively thinned for vigour showed an initial advantage due to removal of smaller seedlings, but in the end, selected and unselected families showed practically no differences.

Results of Harvesting.

The trees were felled and the bark stripped during April, 1954, with the results summarized in Table V. Although conditions for stripping were good in both trials, it was not possible to remove the bark from a number of trees.

The failure to strip was due to a number of causes amongst which were disease, breakage of tops at an earlier period of growth, and suppression by more vigorous trees. Analysis showed that the number of trees which failed to strip differed significantly between families, so presumably this characteristic has a genetic basis. Since a number of factors are concerned, a more detailed study would be required to determine the precise characters which cause the differences.

Percentage stand also differed significantly between families and here again, it must be assumed that germination and survival rate are partly controlled by hereditary factors. There were also significant differences between the families for diameter, but differences in height were no longer significant. Bark weights showed very marked differences between families, but, since yield of bark must be related in some degree to percentage stand and the number of trees which could not be stripped, these differences could have been due entirely to variation in stocking and stripping. Analysis of the data by co-variance showed, however, that not only was there a varietal difference in stand, but also that significant differences in bark yield occurred even when allowance is made for stand. In other words, even had the stand in all families been equal, there would still have been a significant difference in bark yield.

Correlation.

A number of correlations were studied in an attempt to clarify the relationship between the characters. In black wattle, yield of bark was positively correlated with stand, diameter, and height. There was no correlation between stand and height or between stand and diameter. This is contrary to general experience in silvicultural experiments involving no varietal factors, where there is a well-marked negative correlation between stand and diameter, i.e. the higher the stocking the lower the mean diameter. In the Sweetwaters trial, the family with the poorest stand (No. 16) also had the smallest mean diameter and it would seem that varietal factors outweighed and obscured the usual correlation.

There was a significant positive correlation between mean diameter measured in March, 1945, when the trees were two years old, and the final bark yield. Height measured in July, 1946, was also positively correlated with yield, but prior to that date, the correlation did not reach the level of significance.

The results of the green wattle trial were again different. Families differed in yield of bark, stand, and diameter, but not in mean height. Although diameter and yield were correlated as in black wattle, there was no correlation between height and yield or between stand and yield. This difference was possibly due to the much more uniform stand in green wattle as compared with black. The correlations of yield of bark with diameter and with height in the early stages of growth were not significant in green wattle.

The differences between the two species are of some interest. Green wattle gave a much higher percentage stand than black and there was less variation between families. The mean height of the two species was about the same, but green wattle had a lower mean diameter. In bark yield, black wattle was much more variable and, although the

TABLE V

Black and green wattle. Final stand, stripping, and bark yield results

Black wattle							Green wattle						
Family number	Trees per plot	Stand %	Failed to strip %	Yield of green bark			Family number	Trees per plot	Stand %	Failed to strip %	Yield of green bark		
				per plot lb.	% of mean	tons per acre					per plot lb.	% of mean	tons per acre
1.. ..	80	88·9	23·8	973	151·4	13·0	G2	83	92·2	24·1	678	94·6	9·1
1S ..	80	88·9	11·2	1112	173·2	14·9	G3	86	95·6	25·6	685	95·6	9·2
3.. ..	75	83·3	33·3	597	92·9	8·0	G4	85	94·4	21·2	707	98·6	9·5
3S ..	75	83·3	44·0	529	82·3	7·1	G5	87	96·7	18·4	786	109·6	10·5
5.. ..	66	73·3	28·8	573	89·1	7·7	G6	84	93·3	14·3	768	107·1	10·3
6.. ..	52	57·8	42·3	467	72·6	6·2	G7	87	96·7	24·1	866	112·8	11·6
7.. ..	74	82·2	31·1	790	122·9	10·6	G8	87	96·7	17·2	783	109·4	10·5
10.. ..	58	64·4	32·7	558	86·8	7·5	G8S	88	97·8	15·9	799	111·4	10·7
11.. ..	78	86·7	55·1	399	62·1	5·3	G13	82	91·1	30·5	598	83·4	8·0
12.. ..	52	57·8	23·1	602	93·6	8·1	G14	71	78·9	22·5	652	90·9	8·7
13.. ..	67	74·4	20·9	780	121·3	10·4	G15	82	91·1	35·4	615	85·8	8·2
14.. ..	72	80·0	19·4	736	114·5	9·8	G15S	88	97·8	28·4	645	90·0	8·6
16.. ..	26	28·9	30·8	233	36·2	3·1	GC	84	93·3	25·0	738	102·9	9·9
C ..	63	70·0	25·4	651	101·3	8·7							
Mean ..	65·6	72·8	30·1	643		8·6	Mean	84·1	93·2	23·2	717		9·6

average over the whole experiment was lower than for green, the highest black wattle yield was higher than the highest green.

Discussion.

The Sweetwaters experiments show a pattern of behaviour which has come to be recognized as typical of later trials, namely, that open-pollinated progeny of individual trees show hereditary differences in vigour, survival rate, etc., but that visible characters of the parent trees do not necessarily appear in their offspring. In the light of more recent knowledge, this is not surprising. When the Sweetwaters trials were started, little or nothing was known about pollination in wattle. If the species had proved to be self-pollinated, at least some of the characters of the parent trees would have been expected to appear consistently in the offspring. Since, however, wattle has been found to be largely cross-pollinated, such a straightforward transmission from parent to offspring is unlikely. The bark and stem characters for which the parent trees were selected are probably recessive or partially recessive, in which case the character would be obscured in the next generation by the prevailing cross-pollination.

The chief importance, however, of these Sweetwaters experiments lies in the fact that, being the first completed trials of this nature, they have served as a guide in planning subsequent trials and have given some idea how much reliance can be placed on behaviour in the early stages of growth in assessing mature value. Obviously, it is not feasible to wait some ten years for harvest time before proceeding with the next steps in the breeding programme. The assessment of important differences must be made as early as possible in the growth cycle and, in the absence of definite knowledge, the assumption must be made that such differences in important characters as are evident at a young stage will be carried through to maturity. Such assumptions can be misleading, but this possibility must be accepted until such time as more definite evidence is forthcoming. The Sweetwaters trials provide the first concrete evidence of the relationship between the early stages of growth and the bark yield at harvest. In the black wattle, at least, it would seem that at two years of age, a fairly good estimate of the relative vigour of the family and, indirectly, of the bark yield can be made. Later progeny trials, as far as they have gone, seem fully to support the finding that relative differences in vigour tend to be maintained as the trees grow older. In green wattle, this relationship is not so well maintained, and this fact does throw some doubt on whether it will be possible to estimate final relative vigour from early growth records in all black wattle trials. There are, however, numerous subtle differences between the two species and possibly the growth sequence of green wattle is somewhat different from that of black.

NOTES ON INSECTS OBSERVED DURING THE PERIOD 1955-1956

By L. L. J. OSSOWSKI

An account is given of the insects observed damaging wattle plantations in Southern Africa during 1955–1956 and of the areas affected. Several insects not previously recorded as potential wattle pests are listed.

The population of some insects increased during the year under review, notably that of the bagworm, of a lasiocampid, and of some chafers. Eight insects hitherto not recorded as potential wattle pests were observed to do considerable damage over large areas. In areas with a high rainfall, a decrease was noted in the population of jassids and capsids and of the citrus thrips.

I. ORDER : LEPIDOPTERA

Family: *Psychidae*

1. *Wattle Bagworm,* Acanthopsyche junodi *Heyl.*

The area infested with bagworms during the past season amounted to some 90,000 acres, i.e. somewhat more than during 1954-55. The population increased considerably in the Midlands of Natal, especially in the New Hanover and Umvoti Magisterial Districts, where, in spite of an extensive aerial spraying programme during the past three years, approximately 49,000 acres were infested and over 10,000 acres completely defoliated.

In the southern area, particularly around Bizana and Flagstaff, the infestation is still building up. Natural mortality is very low and it appears that the infestation there entered the prodromal stage during the past season. In the eastern part of the Paddock district, the infestation is slowly building up, while other parts of that area appear to be nearly free of bagworms. Around Harding and Ixopo, the bagworm population is still at its endemic level, but it may happen that during the coming season, a slight increase will take place.

In the Pinetown District, bagworms are on the increase, especially in the drier areas bordering on thornveld, and it appears that several hundred acres may become partially or completely defoliated during the coming season. Plantations in the Karkloof area carry a fairly high bagworm population, but the incidence of *Isaria* is also very high there and only a few plantations in the eastern part are likely to become slightly defoliated. Around Lion's River, the bagworm population is still increasing and several hundred acres lying in the direction of Dargle will be partially or completely defoliated. The main centres of infestation are in the Midlands of Natal, and defoliation over large areas, especially around Wartburg, York, Fawnleas, Harburg, Rietvlei, and Albert Falls, is to be expected in 1956-57. The infestation east of Pietermaritzburg is rapidly increasing and the eruptive stage may be reached during the coming year. Approximately 300 acres were partially defoliated during the period under review and some 500 acres will suffer defoliation during the coming season. The infestation around Greytown is decreasing and in the Kranskop area it is back to its endemic level, though here and there, a very slight increase of the population has become noticeable. In Zululand also, the bagworm population seems to be in its normal stage. Only in one plantation north-west of Melmoth has the number of bagworms increased. North of Vryheid, the infestation is rapidly decreasing, but in the lower-lying plantations east of Vryheid, particularly around Glückstadt, an increase in the number of bagworms has been noticed and the infestation appears to have entered the first year of the prodromal stage. Wattle plantations in the Transvaal and Swaziland are practically free from bagworms except around Piet Retief, where the infestation is slowly building up and some 200 acres show a light infestation.

Over one-quarter of the 8,000 acres in the Transkei are infested and nearly 1,000 acres were partially defoliated around Umtata, Mt. Ayliff, and Mt. Frere. The infestation is in its prodromal stage.

Mortality due to *Isaria* was, as usual, particularly high in plantations more than 4,000 feet above sea level, while mortality caused by *Entomophthora* fungus was fairly even over all plantations. Bagworms killed by nuclear polyhedrosis were found mainly in plantations where the infestation had entered the prodromal stage, though this disease was also fairly common in plantations carrying fewer bagworms. It was noticed again that in plantations sprayed from the air, the percentage mortality caused by predaceous and parasitic insects in the months following aerial treatment was lower than in neighbouring unsprayed plantations. This was particularly evident where large, compact areas were treated.

There are old records of wattle bagworms occasionally feeding on orchard and garden trees, and they have recently been found freely on pine (Ossowski, 1953). In the past year, however, they were found defoliating oaks and eucalypts and were also abundant in orchards and gardens, where they attacked tamarisk, ornamental wattles, rose, apple, guava, and bramble (Pl. I, figs. 1—10).

During the year under review, 85,574 bagworms were collected and examined to assess the natural mortality and determine its causes. The following table gives some of the findings according to the months of examination:

Month	Number of		% Mortality due to							Empty bags %	Total mortality %
	plantations	bagworms	Isaria	Entomophthora	nuclear polyhedrosis	diptera	hymenoptera	spiders	unknown causes		
March	7	8,776	15·8	10·0	6·0	0·9	1·6	0·03	0·07	4·7	39·1
April	11	13,169	25·2	14·3	3·6	1·5	0·9	0·1	0·1	6·2	51·9
May	8	14,279	18·8	21·6	6·4	1·1	3·3	0·4	0·3	5·5	57·4
June	16	22,619	21·8	24·0	3·3	1·5	3·4	1·0	0·4	9·2	64·6
July	9	18,015	40·7	18·0	3·1	0·8	2·5	0·4	0·2	12·0	77·7
August	9	8,716	29·2	23·9	3·8	1·2	2·6	0·02	0·08	12·4	73·2

Family: *Lasiocampidae*

2. *Small Wattle Lappet Moth*, Anadiasia punctifascia *Wlk.*

Some 3,000 acres of wattle plantations were infested in the Paddock area and out of this, nearly 2,500 acres were completely or partially defoliated. It appears that severe outbreaks of this pest are recurring in that area every three to four years, the last heavy infestation having taken place in 1952, when approximately 4,000 acres were infested and partially defoliated.

Around Pietermaritzburg, approximately 300 acres were heavily infested. The infestation was, however, kept in check by predaceous and parasitic insects, the shieldbug, *Glypsus maestus* Germ., the caterpillar-killer, burrowing wasp, *Amnophila beniniensis* Pal. Beauv., and a parasite of the *Charops* species being instrumental in reducing the larval population to its endemic level, thus preventing trees from becoming defoliated.

3. *Grey Wattle Lappet Moth*, Pachypasa truncata *Wlk.*

An outbreak of this pest was observed around Greytown, where 370 acres of older wattles were infested. Nearly every tree trunk carried at least one nest of the larvae, and some 75 acres were completely defoliated. Stripping in this area had to be interrupted for several weeks.

WATTLE BAGWORM ATTACKING PLANTS OTHER THAN TAN WATTLE

1—rose, 2—bramble, 3—oak, 4—Acacia podalyriaefolia, 5 and 8—Pinus patula, 6—tamarisk, 7—eucalypt, 9—apple, 10—guava.

Another outbreak was reported from Ermelo, where some 300 acres were infested and partially defoliated.

Family: *Saturniidae*

4. *Willow Tree Emperor Moth,* Gonimbrasia tyrrhea *Cram.*

All the wattle plantations in the Cofimvaba area, which were defoliated by this pest in past seasons, have been felled and replaced by eucalypts, and no infestation was reported from these areas. Some 60 acres of wattles were infested around Umtata and Tsomo in the Transkei, and 40 acres were partially defoliated.

Family: *Tortricidae*

5. *Wattle Webworm,* Polychrosis incultana *Wlk.*

Outbreaks of this pest were observed in the Vryheid area, where they coincided with an attack of froghopper.

II. ORDER. COLEOPTERA

Family: *Melolonthidae*

6. *Large Wattle Chafer,* Hypopholis sommeri *Burm.*

This beetle damaged nearly 2,000 acres of wattle, mainly one to two years old. The population seems to be steadily increasing, especially in the Port Shepstone district, where some 400 acres were partially defoliated. The outbreak was also severe in plantations around Ixopo, where over 500 acres were infested and defoliated.

7. *Small Wattle Chafer,* Monochelus calcaratus *Burm.*

Outbreaks were particularly severe in the Greytown and Rietvlei areas, where over 500 acres were damaged by this beetle, and near Ixopo, where the infestation spread over nearly 1,000 acres, defoliating approximately 400 acres of one-year old plantations.

8. *Mashonaland Chafer,* Eulepida mashona *Arrow.*

The population of this pest, which seriously endangered the establishing of wattle plantations in the Melsetter district of Southern Rhodesia from 1950 onwards, is rapidly declining. This is partly due to the use of soil insecticides in nearly all newly established plantations and partly to the cessation of breaking up of large, compact areas of virgin land for the establishing of wattle plantations. It appears that the larval population of the Mashonaland chafer is returning to its endemic level.

9. Schizonycha spec. indet.

Adults of this insect were reported to have invaded 320 acres of wattles around Langkrans in the Vryheid district, completely defoliating 60 acres of young plantations. The species has so far not been determined, but appears to be closely related to *S. carbonaria* Boh.

Family: *Chrysomelidae*

10. *Iridescent Wattle Chrysomelid,* Colasposoma fulgidum *Lef.*

The number of these insects seems to be increasing and damage was observed in very young plantations near Greytown and Umzinto, where over 400 acres were infested and partially defoliated. The infestation by this beetle coincided with an outbreak of the small wattle chafer.

Family: *Curculionidae*

11. *Fuller's Rose Beetle,* Pantomorus Godmani *Crotch* (Aramigus Fulleri *Horn*).

This beetle was observed to damage and defoliate approximately ten acres of wattle near Hilton Road. Mainly young trees and wattle undergrowth were attacked.

12. Ellimenistes laesicollis *Fhs.*

This curculionid, hitherto known to attack eucalypts only, was observed damaging young wattles over an area of 20 acres in Hillcrest. The main damage is done by chewing the bark of thin branches. In consequence, tops are broken off and crowns become deformed.

Family: *Lamiidae*

13. Eunidea pusilla *Dist.*

Damage done by this longhorn beetle was observed in plantations near Wartburg. Trees up to 20 feet high were damaged and it was noticed that the attack on trees on the outside of plantations was heavier than on those growing inside. *E. pusilla* was usually found together with *E. strigata* Fhs., and *Sinoxylon ruficorne* Fabr. The larvae of *E. pusilla* confine their work to the layers of wood just underneath the bark, where they make irregular series of galleries, which often become confluent, and then make large shallow cavities underneath. When ready for pupation, the larva makes a little canal towards the centre, where the pupa forms and transforms into the adult.

Family: *Bostrychidae*

14. Apate anceps *Fabr.*

This bostrychid was observed to damage younger wattle trees in the Sevenoaks area. The adults gnaw through the bark into the wood, cutting a circular or semi-circular gallery around the branches or thin stems, thus girdling them. Then they tunnel their way to the centre of the branch or stem, making a longitudinal gallery for depositing the eggs. The larvae, after hatching, bore further galleries which are packed with debris. Pupation takes place in galleries bored in the exterior part of the tree. Damage is done mainly by girdling the trees, which break off above the point of attack.

15. Apate indistincta *Murray.*

This beetle was reported to attack only *Casuarina* and *Eucalyptus* spp., *Grevillia robusta, Jacaranda mimosaefolia,* and citrus trees in South Africa (Tooke, 1949), and tung and almond trees and coffee bushes in East Africa (Schmidt, 1954). In the season under review, it has been found, together with *A. anceps,* damaging wattles. The tunnels of this species usually enter the tree radially, turning upwards when the heartwood is reached. Mainly trees up to two years are attacked, and in older trees, the damage is confined to thinner branches.

III. ORDER. ORTHOPTERA

Family: *Acrididae*

16. *Elegant or Soldier Locust,* Locusta elegens (*Thunb.*).

Damage done by this locust was reported from Zululand, where approximately 20 acres of young trees were completely defoliated. Thinner top parts of the trees were also damaged by being chewed. In consequence, tops broke off and crowns became deformed.

IV. ORDER. ISOPTERA

Family: *Termitidae*

17. Macrotermes Natalensis *Haviland S. lat.*

This species of termite was reported to damage mainly tap roots of younger wattle trees in the Kranskop and New Hanover districts. Over 300 acres were severely damaged and had to be re-established.

V. ORDER. HEMIPTERA

Families: *Jassidae* (*Cicadellidae*) and *Capsidae* (*Miridae*)

18. *Large Green Jassid,* Bythoscopus cedaranus *Naudé,* and

19. *Brown Capsid,* Lygidolon laevigatum *Reut.*

There was less evidence of this pest in 1955-56 in areas with higher rainfall, but in drier parts of the wattle belt, damage was severe, especially around Pinetown, in the lower-lying parts of Zululand, and in the Port Shepstone District, where nearly 4,000 acres were infested and approximately 2,500 acres defoliated.

It was reported from Southern Rhodesia that these sucking insects were abundant there also, particularly in the drier and lower-lying parts. Several hundred acres of young plantations were almost completely defoliated.

Family: *Lydaeidae*

20. *The Twig Wilter,* Holoptera alata *Westw.*

Damage done by this sucking insect was evident in young plantations near New Hanover, where over 10 acres were damaged. Mainly tops of trees were attacked, resulting in damage similar to that caused by "froghopper".

VI. ORDER. THYSANOPTERA

Family: *Thripidae*

21. *Citrus Thrips,* Scirtothrips aurantii *Faure.*

The attack was less severe in 1955-56 and damage was observed only over 250 acres of green wattle. There was no evidence of damage to black wattle except for some single trees growing among stands of green wattle.

Acknowledgements.

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SPRAYING EXPERIMENTS WITH INSECTICIDES AGAINST WATTLE BAGWORM (*ACANTHOPSYCHE JUNODI* HEYL.)

By L. L. J. OSSOWSKI

Single-tree plots were sprayed from the ground with four different insecticides, viz. Endrin, Toxaphene, DDT, and a commercial preparation RX2, the last being described as a mixture of allyl derivatives of polyglycerine. The insecticides were dissolved in light diesel oil, Endrin at the rate of 0·67 ounce per gallon of solution and the others at one pound per gallon, and applied at the rate of three gallons per acre. One experiment was carried out when the bagworms were in their earlier instars and another when the insects were older. These experiments were supplemented by three commercial-scale trials, where Endrin and Toxaphene were sprayed from the air at the same rate and concentration as in the experiments. The mortality was assessed 7 days after spraying in the first experiment, after 15 days in the second, and after 21 in the commercial trials. The rate of "fall-off" of dead and moribund larvae was also determined.

There was no significant difference between the insecticides when they were applied against bagworms in their earlier instars, but Endrin was significantly superior to the others when used later. The field trials have shown that whether using Endrin or Toxaphene, a high kill may be obtained provided there is good cover and deep penetration. Otherwise, the overall kill is not high enough to prevent trees from becoming defoliated or to prevent carry-over of the infestation into the next season.

Up to 1954, Toxaphene was used almost exclusively for large-scale spraying against the wattle bagworm. In 1954, however, Endrin was introduced, and as far as can be ascertained, approximately 400 acres were sprayed in that year with this insecticide. The sprayed plantations were kept under observation for several months and, although the mortality was very variable, there were indications that Endrin was highly toxic to the insect. In order, therefore, to obtain more critical evidence, two pilot experiments were carried out during the 1955-56 season. In addition to Endrin and Toxaphene, two other insecticides, DDT and RX2, were tested. The Toxaphene and Endrin treatments were supplemented by controlled commercial-scale trials in three different parts of the wattle growing area.

Plot Layout and Description.

In both pilot experiments, five treatments, including control, in eight-fold, replicated, randomized, single-tree plots were applied. The trees, approximately one year old, were from 10 to 15 feet high and could, therefore, easily be sprayed from the ground. The distance between the rows used was approximately 20 feet, and that between sample trees in the rows 90 feet. For the supplementary commercial trials, three plantations, each 90 acres in extent, but of different ages, were selected.

Insecticides and Methods of Application.

The first experiment was started on 3rd November, 1955, when the majority of the larvae were in their first or second instar, and the second experiment on 20th December, when nearly 80 per cent. of them had reached the third or fourth instar. In each experiment, four different insecticides were used, viz. Toxaphene, Endrin, DDT, and a commercial preparation RX2, described by the manufacturer as a mixture of allyl derivatives of polyglycerine. All the insecticides were dissolved in light diesel oil, Endrin at the rate of 0·67 oz. to one gallon of solution and each of the others at 1 lb. to 1 gallon. The insecticide was applied at the nominal rate of three gallons per acre by means of a "Warley" pneumatic sprayer equipped with a "Watson" nozzle No. 3·5. The pressure was 80 lb. per sq. inch and each tree was sprayed for six to seven seconds. For the commercial trials, only Endrin and Toxaphene were used, at the same dosage and concentration as in the experiments. The insecticide was sprayed from the air by a Piper Super Cub PA 18 A, carrying 46 nozzles with D8 orifices. Light rain which started shortly before the commencement of spraying the first experiment continued during operations and became heavier after completion. A total of 14·9 mm. fell between the time of spraying and sampling, which was undertaken 7 days after treatment. During

the spraying of the second experiment, the sky was overcast, but there was no rain. A total of 28·3 mm. fell between spraying and sampling 15 days later. During the commercial trials, a slight drizzle developed towards the end of operations in one area, while in the others, the sky was overcast during the whole time of spraying, but no rain fell. Wind force throughout the commercial trials did not exceed six m.p.h. No rainfall records were kept for these trials. Mortality was assessed 21 days after spraying.

Method of Sampling.

Directly after the application of the insecticide, sheets were placed under the sample trees so that the "fall-off" of bagworms in the interval between spraying and sampling could be counted. These sheets were examined 24 hours after treatment and on the day on which bagworms were collected for the mortality assessment, which was done according to the method already described elsewhere (Ossowski, 1954).

At the time of examination of the larvae in the first experiment, 20 per cent. were in their first instar, 78 per cent. in their second, and 2 per cent. in their third. In the second experiment, 21 per cent, were in their second instar, while 48 per cent. had entered their third and 31 per cent. the fourth instar. In the commercial trials, 70 to 75 per cent. of the larvae were in their second instar and the remainder nearly equally divided between the first and third.

Results.

In the first experiment, three trees out of the eight sprayed with RX2 and two in each of the other treatments had a complete kill. There was, however, no significant difference in the mean percentage mortality (Table I) in the four treatments.

TABLE I

Mortality of bagworms in early instars 7 days after treatment

Insecticide	Total mortality %		Mean corrected kill %
	Range over 8 replicates	Mean	
DDT	87·5 — 100·0	95·2	92·4
Endrin	75·0 — 100·0	95·9	93·5
RX2	78·8 — 100·0	95·6	93·1
Toxaphene	93·0 — 100·0	96·3	94·1
Unsprayed control ..	26·7 — 44·3	36·5	—

Standard error	2·16
Significant difference (P=0·05)	6·27
Significant difference (P=0·01)	8·59

In the second experiment, four trees sprayed with Endrin, three with DDT, two with RX2, and one with Toxaphene had a complete kill. The mean corrected kill (Table II) was significantly higher (P=0·05) in trees treated with Endrin than in the other treatments, which did not differ significantly amongst themselves.

TABLE II

Mortality of bagworms in older instars 15 *days after treatment*

Insecticide	Total mortality %		Mean corrected kill %
	Range over 8 replicates	Mean	
DDT	77·4 — 100·0	91·5	90·2
Endrin	95·6 — 100·0	97·8	97·4
RX2	71·8 — 100·0	91·8	90·6
Toxaphene	75·4 — 100·0	92·0	90·7
Unsprayed control ..	7·0 — 44·4	13·5	—

Standard error .. .. 2·25

Significant difference (P=0·05) .. .. 6·51

Significant difference (P=0·01) .. .. 8·79

In the commercial trials, a very high mortality was obtained in young plantations with an open or interrupted canopy, but in older plantations with a dense canopy, the penetration apparently was not deep enough to ensure a high kill (Table III). Such plantations sprayed under favourable weather conditions with either Endrin or Toxaphene showed a range of kill from 53·4 to 100·0 per cent., but the overall mortality was not high enough to prevent the trees from being defoliated and the surviving population was sufficient to carry over the infestation into the following season.

TABLE III

Mortality of bagworms in commercial-scale trials

District	Age of trees	Height of trees	Description of canopy	Insecticide	Total mortality %		Mean corrected kill %
					Range over 6 sample trees	Mean	
Dalton	12—18 months	6—12 feet	open	Toxaphene	—	100·0	100·0
				Endrin	86·4—100·0	97·5	96·5
				Unsprayed control	20·3— 33·6	29·4	—
Rietvlei	18 months	12—18 feet	interrupted	Toxaphene	97·5—100·0	99·5	99·4
				Endrin	95·4—100·0	99·8	99·7
				Unsprayed control	8·6— 42·9	22·3	—
Wartburg	4 yrs.	40—50 feet	dense	Toxaphene	53·4—100·0	81·5	72·0
				Endrin	64·4— 98·3	86·5	78·0
				Unsprayed control	22·8— 45·5	34·0	—

The mean percentage "fall-off" of bagworms in the first experiment was 2·6 in the unsprayed controls and ranged from 5·3 to 6·1 in the trees treated with insecticide. There was no significant difference in the fall-off between the treatments. In the second experiment, the fall-off in the untreated trees was 0·9 per cent. and in the treated ones from 2·2 to 2·9 per cent., with no significant difference between the treatments. The

fall-off in the field trials varied from 1·9 to 2·4 per cent. in untreated controls, from 4·9 to 5·1 per cent. in the plantations sprayed with Toxaphene, and from 5·5 to 8·3 per cent. in those treated with Endrin.

From the results of these pilot experiments and those of the supplementary trials, it would appear that there is no significant difference in efficacy between Toxaphene, Endrin, DDT, and RX2 when bagworm larvae are in their early instars. Endrin, however, is more effective against older larvae. The field trials have also shown that, whether using Toxaphene or Endrin, results are satisfactory only if a good cover and deep penetration have been obtained.

Further evidence on the toxicity of Endrin was obtained from routine commercial spraying in the 1955-56 season. Approximately 2,000 acres were treated and of this area, some 800 acres were inspected after spraying and random samples of bagworms taken from 200 acres. The sampling again showed a very wide range of kill and indicated that Endrin was highly toxic to bagworms when application was satisfactory.

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